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DEMOCRACY AND LEADERSHIP

IN a volume entitled "Recovery : the Second Effort", Sir Arthur Salter outlined a scientific programme of recovery conspicuous for its vision and sense of values. He has now produced an equally comprehensive review* of the international situation to-day, which outlines an equally scientific programme for retrieving security, no longer in the field of economics but in that of power politics. Beyond this, however, Sir Arthur has given us not only a frank and realistic picture of the grave dangers which confront democracy and all that it stands for to-day, not merely a challenge, but also a vision of hope. Through all the dangers which now confront democracy, he sees its innate strength. Its weakness can still be repaired in time if we but bring to the service of its virtues bred and nursed to the pursuit of peace, the sterner virtues of fortitude, energy, the will to act together, the free acceptance of discipline and sacrifice. Faults of organization and leadership can be made good if recognized, and the book is to be welcomed even if only for this reminder that with courage and vision, the recognition of danger and not the refusal to see it, we can yet eliminate the sources of weaknesses in the free democracies.

Sir Arthur opens with a trenchant analysis of the chief material and political factors involved in the present position, and sets in clear relief the dangers confronting the democracies and the factors likely to precipitate conflict or avert it. Scientific workers, no less than the general reader, should welcome this sane and concise review of the situation.

The second part of the book consists of a brief review of the events and ideas which have been responsible for the failure to achieve collective security in the last two decades through the League of Nations. In this review, emphasis is laid in the transformation of the character of the League from the start, through the abstention of the United States and later defections with their consequences.

Sir Arthur Salter urges the undesirability as well as uselessness of attempting amendment of the League Covenant at present. The main task in respect of the League is to keep its organization active and efficient by developing the useful work which it can continue on social, economic and financial and labour questions. This pertinent reminder of the valuable work which is still being done in a number of technical and scientific fields should not be lost on scientific workers. We must have regard both to the practical and to the ideal. The ultimate goal must be either the restoration of the League, or the construction of some other form of collective system, including the revision of treaties by collective negotiation. Until we achieve this, peace must be at best precarious.

The third part of the book, entitled "National Strength", which is the longest of the five, deals with the various factors in the domestic situation. It contains most of the detailed criticism which Sir Arthur allows himself and reveals to the full the author's rich administrative experience and capacity. It is this section, with its highly stimulating and suggestive remarks regarding leadership, that scientific workers should find of special interest. In the fourth part, Sir Arthur outlines his views on present policy to lay the foundation of a new peace. He sets forth proposals for the basis of the discussion of a general settlement with Germany when conditions make the reasonable discussion of such a settlement practicable as an example of what might be possible with the other Axis powers also, while in

* Security : Can we Retrieve It ? By Sir Arthur Salter. Pp. xv+390. (London : Macmillan and Co., Ltd., 1939.) 8s. 6d. net.

the fifth part of the book he discusses the strength and weaknesses of the democracies and totalitarian systems, and summarizes the policy and action required in defence of democracies.

The policy outlined by Sir Arthur has every claim to be described as a scientific policy and as such merits the attention and support of all scientific workers. He reiterates, for example, the case for a Ministry of Supply as a first step in the reorganization needed to enable industry to meet the vast demands of the war services, and the arguments in support of the case with which he has long been associated are marshalled with force and lucidity. Here again he is on ground that is already common with many scientific workers, and this chapter on industrial mobilization deserves their close attention.

Beyond such particular questions, this part of the book raises the fundamental questions of leadership in a democracy. By what is implied, as much as by what is said, Sir Arthur Salter indicates the limitations and defects of leadership in Great Britain in the last decade or more, the lack of vision, the failure not merely to foresee dangers but even to recognize their existence. Once again he directs attention to the dangers of professional departmentalism and to the obstacles it opposes to vigorous and effective action in any new field. Not only in regard to the storage of food and air raid precautions, but also in such matters as the location of industry, Sir Arthur Salter is seriously disturbed at evidence of failure on the part of the Government to realize what is involved, and the charge of executive incompetence which he presses home is the more impressive through its sober restraint.

Inevitably such criticism raises the whole question of the selection of executive ministers in a democracy in times of such stress. Far closer co-operation between the Government service and the public is required if the economic adaptation necessitated in modern warfare is to be achieved and quick and vigorous action facilitated both by the Government and by industry.

To this end several specific proposals are made. The personnel of the Civil Service should at once be reinforced; at the top with the leading men in science and industry, and throughout its ranks with young men of energy and constructive ability, some of whom would be specialists and others, while without specialized experience, should have a trained and adaptable intelligence. In addition to full transfer, Sir Arthur suggests that competent men of energy and constructive ability and useful specialized knowledge in finance and other business houses could be associated at once with appropriate departments on a part-time basis. Stress is also laid on the opportunity for private initiative and, in particular, it is suggested that scientific men, without waiting to be consulted on particular questions, should take the initiative themselves by reviewing in turn the obvious problems in which scientific knowledge is not as yet fully utilized.

In regard to the executive, Sir Arthur suggests a small inner Cabinet of Ministers, relieved of departmental duties, of suitable personal qualities to conceive and elaborate a general policy and furnished with an adequate and appropriate organization. Stressing the importance of national unity, he would broaden the basis of the National Government and suggests the appointment by Parliament of a Committee of Foreign Policy and Defence, consisting of twenty or thirty of the most trusted members of all important parties or groups.

This criticism, which rarely fails to be constructive, is essentially a most stimulating and suggestive essay on leadership in democracy in which, for all its failings, Sir Arthur is a convinced believer. Inadequate preparations are not due to inherent defects in our parliamentary system. Some of the conditions which militate against the selection of requisite administrators and executives of ability are clearly indicated by Sir Arthur, but his essay should at least stimulate much fundamental and constructive thinking about the selection and training of leaders for the highest positions both in industry and in the State. Scientific workers, no less than other members of the community, may well be grateful that Sir Arthur has lent the weight of his unrivalled experience as an administrator to the exposition of the dangers and possibilities of the present situation. The realization of the menace, no less than the message of hope which breathes through the pages of this book, may well assist in overcoming the obstacles to the more centralized direction and coherent planning of all our effort and stimulate the acceptance of the essential discipline and sacrifice. Nor should this constructive and inspiring book fail also to stimulate fundamental thought on the evolution of modifications in our democratic institutions, which will enable them to meet the strain more effectively and to throw up the leaders required, while preserving unimpaired the great traditions which are theirs and theirs alone.

REGIOMONTANUS AND KEPLER

(1) **Leben und Wirken des Johannes Müller von Königsberg genannt Regiomontanus**
Von Ernst Zinner. (Schriftenreihe zur bayerischen Landesgeschichte, herausgegeben von der Kommission für bayerische Landesgeschichte bei der Bayerischen Akademie der Wissenschaften, Band 31.) Pp. xiii+294+46 plates. (München: C. H. Beck'sche Verlagsbuchhandlung, 1938.)

(2) **Johannes Kepler Gesammelte Werke**
Herausgegeben im Auftrag der Deutschen Forschungsgemeinschaft und der Bayerischen Akademie der Wissenschaften. Band 1: Mysterium Cosmographicum. De Stella Nova. Herausgegeben von Max Caspar. Pp. xv+493. (München: C. H. Beck'sche Verlagsbuchhandlung, 1938.) 12 gold marks.

FOR those who date the beginning of modern astronomy from Tycho Brahe, and confine their interest to the subsequent period, there is good excuse. Yet there were great men before that time, who gave themselves to the task of dissipating the intellectual mists of the Middle Ages. As Copernicus is accepted as an impressive figure of the earlier sixteenth century, so Regiomontanus is an outstanding figure in the fifteenth. For various reasons it seems particularly difficult to arrive at a just estimate of the importance of Regiomontanus, and therefore a scholarly monograph on his life and work has great value and interest.

(1) Johann Müller was born in the year 1436 at Königsberg in Franconia, or in the neighbourhood. His surname conveys the family occupation, which was actually followed by his father, but it is by the name Regiomontanus derived from his birthplace that he has become universally known. Before he reached the age of twelve, it is said, he entered the University of Leipzig. That this was no ordinary instance of precocity was quickly shown. In 1448 Gutenberg produced the first printed calendar, giving places of the planets. For the same year there still exists a latin MS in the childish hand of Regiomontanus, which gives the positions of the planets at closer intervals and, as comparison with modern tables has shown, more accurately. Whatever other suggestion may be found to explain away this evidence that the ephemeris is the unaided work of a boy of twelve, it is shown here that no member of the University staff was capable of using the cumbrous astronomical tables available at that time. Leipzig was no place for a young astronomical genius, and so in 1450, still before he was fourteen years of age, Regiomontanus migrated to Vienna.

The choice of this University (founded in 1365) was a good one. It had a tradition in mathematical studies, and J. von Gmunden had established what was for that time a respectable school of astronomy. He himself had died in 1442, but other teachers were not wanting. At an early date Regiomontanus attached himself to Georg Peuerbach, his senior by thirteen years, who became qualified to lecture in the University only some time later. Another factor coinciding with the arrival of the young student and of no little importance for him was the introduction of humanism under the influence of Aeneas Silvius Piccolomini (afterwards Pope Pius II). Thus as a student Regiomontanus enjoyed excellent opportunities both in mathematical and classical subjects. The granting of his master's degree was delayed until his majority, and thereafter he lectured in the University, it might be on Euclid or it might be on Vergil. Throughout he enjoyed the position of favourite pupil and assistant to Peuerbach.

Little or no light is thrown here on the nature of his financial resources. The omission is easily understood, but it is to be regretted. Presumably he was self-supporting from necessity, and his sources of income were his horoscopes, such as those compiled for Leonora of Portugal on her marriage and for the future Emperor Maximilian I, her son, and a series of year-books. The second of these horoscopes is here reproduced among a number of interesting plates. The year-books contain astrological data then in great demand, not least among physicians for the practice of their calling. It would appear that the astrological rules were fixed and recognized. All that remained to be done was to supply the astronomical predictions according to the scientific skill of the computer. In his department Regiomontanus enjoyed a not undeserved reputation from early youth.

It is but fair to recognize that the crass superstition of the age provided a valuable incentive to true astronomical research. It became plain that the planetary tables, either the Alfonsine Tables, now two centuries old, or derivatives from them, like Bianchini's, were extremely defective. To Peuerbach and his pupil the errors presented a scientific problem. As the tables were based on Ptolemy, the line of advance in the first instance was to go back to the Almagest in order to understand clearly what his theory was. The outcome

was the Epitome, a work which Peuerbach did not live to finish.

Now comes on the scene the Greek cardinal Bessarion, who arrived in Vienna as papal legate in 1460. In the following year he persuaded Peuerbach to return to Rome with him, accepting the condition that the pupil should go too. On the eve of setting out, Peuerbach died, and Regiomontanus went with the cardinal alone. With his cultured patron he spent the next four, or possibly six, years, living in Rome or visiting other cities like Venice, where he discovered a unique manuscript of Diophantus. The collecting or copying of manuscripts was part of his task. But his first great work in Italy was the completion of the Epitome Almagesti begun by Peuerbach. This is a version of Ptolemy simplified by the mathematical form introduced by the Arabians and incorporating some of their main results in astronomy. Its great importance lies in the fact that this version came later into the hands of Copernicus and Kepler, and its critical comments had undoubted influence. The second great work, also written in Rome, is that on trigonometry, spherical and plane. This belongs to the history of mathematics. It may be difficult to distinguish the parts that are truly original, but on questions of plagiarism the only safe course seems to be to assume that Regiomontanus knew all that was to be known from his predecessors, for he was a remarkably learned man, and to remember that he was writing a text-book, not a history of the subject.

The years 1467–71 were spent in Hungary. Here superstition was rife, and both Vitez, the immediate patron of Regiomontanus, and the king, Mathias Corvinus, had complete faith in astrology. But the man of science, for he must have been truly that, remained unperturbed. On the reasonable plea that the required calculations were highly laborious in the absence of suitable mathematical tables, he produced extensive tables of the sine and tangent. Then for the necessary observations he collected for the king the finest instruments to be procured—dials, astrolabes and cross-staffs. For the most part these have been dispersed and lost, though not all. His own observations, so far as they have been preserved, were few, but others may not have survived.

So far as can be seen, the scientific outlook of Regiomontanus was always thoroughly sound. The Ptolemaic system must be understood, but he had less illusion about its nature than anyone, except perhaps Ptolemy himself. It was merely a means of calculation, and far from satisfactory at that. The lunar theory, which gave a palpably impossible range to the apparent semi-diameter of the moon, was enough to show it. But before any real advance could be made in the theory, it was necessary to recognize that the ancient observations were thoroughly inaccurate and the science must be reconstructed on a foundation of modern observations. All this Regiomontanus saw and stated as clearly as Tycho could have done. Therefore, when in 1471 he saw trouble brewing between his archiepiscopal patron and the king, he persuaded Mathias to allow him to establish an observatory and settled in Nuremberg with that object in view.

But once there, his activities took a completely different turn. He set up a printing press and immediately embarked on a most ambitious scheme of publication. The actual output amounted to no more than nine works, almost exactly contemporaneous with Caxton's earliest undertakings, but the details of the whole plan were announced in a catalogue here described. Moreover, some of these works presented all the difficulties of mathematical printing, with figures reproduced in the form of wood-cuts. On the technical side of this achievement it will be recalled that a generation later Dürer was at work on the same spot. But the duty of making observations was not neglected. Regiomontanus collected and installed the necessary instruments, made observations himself and, not least, trained his successor Bernhard Walther to continue this side of his work. Walther observed assiduously between 1475 and the year of his death, 1504, and his results, though published later without the care and completeness they deserved, are the most important in the long interval between the Greeks and Tycho Brahe.

But the man who had started this new epoch had vanished from the scene. He may have been summoned to Rome to advise on a revision of the ca'endar. In 1475 he left Nuremberg and the following summer died in Rome, perhaps a victim of the plague then prevalent in the city. A tradition that he died by poison cannot be traced farther back than 1512, and though it was transmitted by Rheinhold, it is here discredited. Indeed nothing is known of this last year of his life. The printing press came to an abrupt end, and the great plans of its founder with it. As much of his work, like the instruments he assembled, has been scattered and lost, it is unusually difficult to assess the scientific importance of Regiomontanus. But this is a point to which there will be occasion to return later.

(2) The first volume of the new edition of Kepler's works has now appeared, following the third, which contained the Astronomia Nova and was published at the end of 1937. Naturally it is in the same form as the volume already noticed in the course of last year (NATURE, 141, 665; 1938), and it reaches the same high standard in its

presentation. The Latin text of two of Kepler's earliest works is followed by an illuminating editorial commentary in German.

All that Kepler wrote must be considered valuable as a revelation of his personality and trend of thought. But the "Mysterium Cosmographicum" (1596), a short work, is scarcely, taken by itself, an attractive one. It has two merits. The Copernican system is adjusted to a more truly heliocentric form. Also the basic conjecture, absurd as it is, is subjected to the test of careful calculations. But here at the outset of his career Kepler reveals himself as a complete scientific mystic. A copy was sent to Galileo, who returned a polite but perfunctory acknowledgment. After that he was not to be drawn into further correspondence on the subject; and little wonder, for Galileo was anything but a mystic. Perhaps this example may suggest a reason why Kepler's greater work failed to find recognition among the next generation. Like Galileo, others may have been alienated by the mystical element and may have failed to probe and find the real treasure.

The second work contained in this volume is known by the short title "De Stella Nova" (1606). The star is Nova Ophiuchi (1604), and Kepler was naturally the more interested in it because he had recently assisted Tycho Brahe in editing his observations of Nova Cassiopeiae (1572). The appearance also was the more remarkable because it occurred near a conjunction of Jupiter, Saturn and Mars. Another strange and previously unknown star had been discovered in 1600, and Kepler included an account of it as a new star; it is the variable P. Cygni, not now accepted as a *nova*.

To an ounce of science in this work there is an intolerable deal of sack. Writing with an eye on his public, Kepler must give his views on the astrological significance of the triple conjunction with characteristic verbosity. No sooner has he dealt shrewdly with one school of superstitious thought than his mysticism leads him back into equal extravagances. Of greater interest are his views on the nature of the stars. But his notions of sidereal astronomy were always completely antiquated. The ideas of Giordano Bruno filled him with horror ("nescio quid horroris") at the mere thought. Yet they had probably been picked up during a visit to England twenty years before. The essential part can be traced to Thomas Digges's work, a "Perfit Description of the Cœlestiall Orbes" (1576). The immensity of stellar space, from which Kepler recoiled, had been accepted as obvious by Copernicus.

It is now possible to return to Regiomontanus. When Mästlin undertook to produce the "Mysterium Cosmographicum" for Kepler, it seemed to him that some introduction to the ideas of the Copernican system was wanted by the uninitiated. He had the happy thought to add to Kepler's work (1596) the "Narratio Prima" (1540) of Rheticus. This tract is once again reprinted, and it is a most important document, for in the circumstances in which it was written (as an open letter addressed to J. Schöner) it must have had the approval, if not the positive inspiration, of Copernicus. The reference to Aristarchus, never made by Copernicus himself, is to be found here. The tradition was familiar to all about that time. Regiomontanus had marked "Aristarchus samius" in the margin of his copy of Archimedes, showing what was in his mind. Robert Recorde recognized the ancient source immediately. It would have been strange if the tradition, which was a perfectly explicit one, had not had its full effect on Copernicus.

There are also references to Regiomontanus, chiefly to the Epitome. But the passage which bears on his greatness runs thus:

Principio autem statuas velim doctissime D. Schonere, hunc Virum, cujus nunc opera utor, in omni doctrinarum genere, et astronomiæ peritia Regiomontano non esse minorem; libentius autem eum cum Ptolemæo confero, non quod minorem Regiomontanum Ptolemæo aestimem, sed quia hanc felicitatem cum Ptolemæo Praeceptor meus [Copernicus] communem habet, ut institutam astronomiæ emendationem, divina adjuvante clementia, absolueret, cum Regiomontanus (heu crudelia Fata) ante columnas suas positas e vita migrarit.

The marginal note "Regiomontanus Romae veneno extinctus est An. 1476, 8. Julii, aetatis anno 40. vix completo" was supplied by Mästlin, and of course adds no weight to the earlier report of Rheinhold.

The judgment of Rheticus is valuable in itself, because he was a sensible man, with access to material and verbal traditions no longer available, and there is no reason to suspect hero-worship in this case. But more than this, it must have been endorsed by Copernicus himself, for otherwise there can have been no reason for introducing the name of Regiomontanus at all. This tribute is not to be lightly dismissed like some of the undiscriminating eulogy which has had a prejudicial effect on his reputation in later times.

The subject of Regiomontanus has been dealt with at some length in this review because in his "Planetary Systems", generally a trustworthy work, Dreyer has done far less than justice to this very remarkable man. Had he been spared another thirty years of active life, what might he not have accomplished? Heu crudelia Fata.

H. C. PLUMMER.

PLANT PHYLOGENY

Textbook of Paleobotany

By William C. Darrah. (Century Biological Series.) Pp. xii+441. (New York and London: D. Appleton-Century Co., Inc., 1939.) 25*s*. net.

THE publication of a short but comprehensive text-book of palæobotany in English is a noteworthy event, for great progress has been made during the last forty years in our knowledge of fossil plants, and the discoveries of the latter half of this period must eventually revolutionize many widely accepted views on evolutionary morphology. The author, who is a member of the staff of Harvard, has all the enthusiasm of youth, and has produced a book which covers a very wide field of study. The subject is treated mainly from a phylogenetic point of view, the historical evidence relating to each of the main groups of plants being considered. A few chapters are devoted to a review of the floras of the great geological epochs and to more general topics. Each chapter is accompanied by a bibliography of the more important papers, mainly from recent publications. There is a large number of illustrations which add to the interest and value of the book. Many of them are reproductions of photographs of actual specimens, though these vary in quality.

The reviewer feels considerable regret that he is unable to give an unqualified recommendation of this volume. It will certainly interest many who wish to know of the progress of palæobotany, and the descriptions of recent discoveries in the Devonian rocks will be useful to teachers. But the author of a scientific text-book has grave responsibilities. His work will provide the foundations upon which the knowledge of many students is to rest; it will largely determine their outlook on the subject. A text-book should be unimpeachable on matters of fact and should be a pattern in logical reasoning. The boundary line between objective observation and inferences drawn from the observations should be clearly discernible, so that the reader may be prepared for the changes in the interpretation of the facts which must come with new discoveries in every healthy branch of science.

From this point of view, the present work is disappointing. The author gives too little space to straight description of structures and too much to considerations of phyletic morphology. The brief mention of many of the well-known Upper Palæozoic and Mesozoic plants, sometimes little more than a catalogue of names, will scarcely allow the student to visualize their structure, and consequently the author's interpretation of their morphological significance must be accepted without question. But this interpretation may be quite speculative, or depend on the definition given to terms which are not explained. Even though a particular interpretation has been widely accepted and may be generally held at the present time, it does not follow that it is really true.

We may take as an example a reference to the Cycadales with which almost every botanist would agree. The author states that the ovules of these plants are borne laterally upon the sporophylls. "The Cycad 'carpel' is typically foliar and is a convincing example of the Phyllospermic type." But in spite of the universal repetition of this view, it cannot be said that it is based on any unquestionable evidence derived from either fossil or modern forms; until such evidence is provided, the view is just a piece of morphological dogma. It would be far better for the student and for the progress of the science to refrain from describing the seed-bearing organs of the cycads as 'carpels' and the pollen-bearing organs of the Bennettitales as 'stamens', even although these terms are placed in inverted commas.

One of the many difficulties which confront the student of fossil plants is the nomenclature used, and it is regrettable that the author did not give some indication of the international rules of palæobotanical nomenclature and classification. It may be mentioned that he has followed these rules in employing the new generic name 'Horneophyton' Barghorn and Darrah for the plant previously known as *Hornea Lignieri* Kidston and Lang. This will in future be the valid name for this important Devonian fossil, since it has been found that the name 'Hornea' was preoccupied.

Unfortunately, a considerable number of errors have got into the text and there are many very questionable statements. *Sphenophyllum fertile* is described as having the structure which Scott, with his limited material, ascribed to it. In the bibliography, however, papers by Leclercq are cited and this work, carried out by means of serial sections, showed that the cone had a very different structure. In view of the far-reaching hypotheses that have been founded on the supposition that cones actually existed having the structure described by Scott, it is surprising that the important work of Leclercq was not mentioned in the text.

In the chapter on the origin of the angiosperms, Darrah favours the view that the flowering plants originated from Cycadeoid-like ancestors. He says, "the modifications which would be required to transform the Cycadeoid flower into that of the

later flowering plants are simple ones". But, unfortunately, he stops there and does not explain what these simple modifications would be, or what evidence he has to show that they have actually occurred. Much of what he says about the Caytoniales appears to be based on a misapprehension. He speaks of Thomas finding the greatest difficulty in demonstrating how the Caytoniales could be the ancestors of the flowering plants, and this, like statements of other recent authors, appears to suggest that the writer of this review advocates the derivation of the flowering plants from the Caytoniales, although he has repudiated it in four different publications since it was ascribed to him. As this misapprehension is finding its way into current teaching, attention must be directed to the statement made in 1930 (paper read at the Fifth International Botanical Congress 1930; *Annals of Botany*, **45**, 670; 1931) and since maintained as a working hypothesis. Thomas wrote: "The flowering plants are considered to be derived from one or more groups of pteridosperms intermediate between those which gave rise to the Bennettitales and Caytoniales".

Of course, it is far easier to criticize a book of this character than to write one, and the ungracious remarks that have just been made refer mainly to the volume as a manual for students. Plant morphologists and those engaged in the study of systematic botany will find information and interest in this work as giving a modern view of the fossil evidence for plant evolution. It shows how much more we need to know and how wide is the gap still to be bridged between the lower and the higher groups of the vascular plants.

H. HAMSHAW THOMAS.

THE SCIENCE OF COLOUR

Colour in Theory and Practice

Vol. 1. General Theory. By H. D. Murray and Dr. D. A. Spencer. Pp. xvi + 176 + 3 pl. (London: Chapman and Hall, Ltd., 1939.) 25*s*. net.

NATURAL colour phenomena have been to a large extent accepted, rather than investigated, until fairly recent times, but our knowledge of what the dictionaries call 'chromatics' is now growing rapidly, and the word may soon lose its unfamiliar and faintly ambiguous savour. Such commercial activities as colour photography and an ever-expanding dye industry are largely responsible for the increasing colour-consciousness of to-day, and the chief stimulus to the study of colour comes from technical, rather than academic scientific, sources. The authors of "Colour in Theory and Practice" have travelled from the particular field of colour reproduction to the general consideration of colour.

But although the present volume is primarily intended as a preliminary to a survey of the applied aspects of colour, it is none the less welcome for its own sake, as a presentation of the basic facts and theories concerning the visible spectrum and its relationships with matter and mind. The authors waste no space on a historical approach to the subject, but begin with a brief résumé of present views as to the origin and nature of light, and from this pass on to an account of the ways in which a coloured or "unbalanced" visible radiation may be produced. The next short chapter, concerning the chemistry of colour, might well have been combined with the review of coloured substances which concludes the book. The consideration of the possible transformations of absorbed light energy would then follow on with uninterrupted continuity of theme. Similarly, the reviewer would have been inclined to put the relatively long chapter on practical light sources (if included in this volume of general theory at all), and the notes on light filters, before, rather than after, the account of spectrometers and spectrophotometers, and follow the latter directly with the important discussion of colour measurement and specification.

With the exception of this chapter ("The Measurement of Colour") the text is not too technical to be intelligible to the layman, and much of it, including the descriptions of the human eye, colour vision and its physiology, and the all too brief notes on colour in Nature, is very pleasantly readable. The authors are careful in their use of terms, and rightly at pains to stress the distinctions between objective and subjective concepts. The diagrams are helpful, although some indication in the graphs of the colours corresponding to various wave-lengths would be a convenience to non-physicists less familiar with the angstrom unit.

References to publications are scattered throughout the pages. The value of the work as a much-needed introduction to colour science would have been greatly augmented by a bibliography.

The book is handsomely produced, with excellent illustrations, including seven pages in colour to hearten the general reader into overcoming his fear of mathematical symbols; but its price is regrettably high.

SAMPSON CLAY.

THE LIVING BODY

A Text in Human Physiology

By Prof. Charles Herbert Best and Prof. Norman Burke Taylor. Pp. xxii+563+15 plates. (London: Chapman and Hall, Ltd., 1939.) 18*s*. net.

A TITLE such as "The Living Body" raises the hope that this is no ordinary text-book of physiology for medical students designed for a group of readers who have already passed their first medical examination and are now studying not only physiology but also anatomy and biochemistry, on each of which they read special books. "The Living Body" suggests, and according to the authors' preface rightly so, an elementary account of how our bodies work, which includes everything, anatomy, histology, biochemistry, as well as the topics commonly included in the narrower sense of medical physiology. Only the most elementary knowledge of physics and chemistry is presupposed, and such a book might well be designed for the intelligent layman who remembers a little of the science he did at school, for nurses, and for others who are not concerned with more specialized aspects of the subject.

There may be some truth in the saying that our generation which reads avidly of the advances in physics and even biology has no interest in physiology because concern with one's body is not quite healthy or not quite proper. Yet many, not only the unhealthy or improper but also those who are healthy enough not to bother about being thought so, and those who are specifically interested in subjects such as the nutrition of the people and athletics, have been asking for a book which will tell them about the spectacular discoveries in physiology and their application to medicine which have featured in the news of the last few decades. To make these discoveries intelligible and interesting they must be accompanied by a general account of the happenings in the body. If such a demand exists, it is certain that it has not been adequately met by physiologists, who have become increasingly preoccupied with the rapid advances in their own special branches of the subject. Occasional works of genius re-fashion the shape of the subject on a wider scale, for example, Bayliss's "Principles of General Physiology" or Barcroft's "Features in the Architecture of Physiology", but these are addressed to readers who are living with the material of physiology. For the non-specialist reader some similar creative effort is needed to break away from the presentation of the subject which has become traditional in connection with the medical curriculum, to reorientate the study of the body around certain themes of immediate social urgency such as nutrition and muscular exercise, and to muster appropriately new selections of our physiological knowledge, much of it recently acquired, which might catch the imagination of the reader as a scientific adventure in exploring the functions of the body.

"The Living Body" scarcely aims so high. It professes to be elementary and dogmatic. It is elementary perhaps most noticeably in the sense that we regard anything we did in our youth as elementary, that is to say it has something of the flavour of the text-book of a generation ago, this impression being reinforced by the unusually high proportion of old friends one recognizes among the illustrations. Many instances of the danger of such a method can be found; for example, Fig. 201 showing the effect of temperature on the isotonic contraction of muscle was in its day a famous example of inappropriate apparatus yielding results which are misleading to the point of being in the opposite direction of those recorded by modern instruments. Other figures emphasize aspects of the subject which have become unfashionable because displaced by the wealth of material nearer the heart of physiology; no less than five figures, for example, depict water flowing through models consisting of rigid tubes, but the properties of the models are not to any extent used to elucidate the features of the blood circulation, the physical analysis of which is now so elaborate that the subject—hæmodynamics as it was grandiloquently called—has almost dropped out of elementary text-books.

The degree of dogmatism which is needed to make a short account of physiology clear to a reader is a hotly disputed subject, and differs according to the aims and tastes of the author. Fashion in physiology has on the whole dictated sparing use of dogmatism about disputed matters when simplicity seems to require it, but has discouraged statements appearing as facts when no evidence about the matter exists. As an example of the less fashionable view taken by the authors on the latter point may be quoted the rather unlikely value of 5 mm. given as the pressure in Bowman's capsule in the mammalian kidney.

"The Living Body" is profusely illustrated and straightforwardly written and meets the requirements of the class of reader, such as nurses and some dental and agricultural students, who requires, as the authors say, "a less scientific and more dogmatic method of instruction than that customary in more advanced texts."

F. R. WINTON.

AERONAUTICAL RESEARCH: WIND TUNNELS, OLD AND NEW

DR. G. W. LEWIS, director of aeronautical research, National Advisory Committee for Aeronautics, U.S.A., delivered the Wilbur Wright Memorial Lecture before the Royal Aeronautical Society on May 25, taking as his subject "Some Modern Methods of Research in the Problems of Flight", with some personal reminiscences of the brothers Orville and Wilbur Wright, and gave some hitherto unpublished details of their original researches into the problems of flight in 1901. Fig. 1 shows profiles and plan forms of some of the aerofoils used by the Wrights in their wind tunnel. It can be seen that models 7, 8 and 9 are circular arcs with a systematically varied camber, and 10, 11 and 12 have a similar camber in a more forward location; also the models have a 1-inch chord with a 6-inch span, giving an aspect ratio of 6. Research up to to-day has universally confirmed that the assumption of these forms was correct to such an extent that it almost appears to have been an extension of their original work. Since this work was never published, these later day conclusions are an independent testimony to their far-sightedness and understanding of the basic principles.

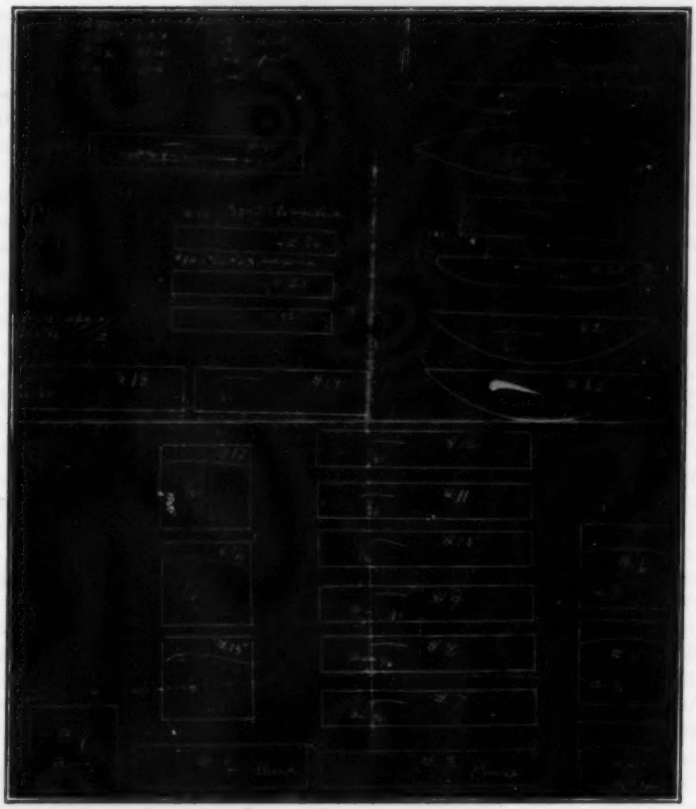

Fig. 1.

REPRODUCTION FROM THE WRIGHT BROTHERS' ORIGINAL RESEARCH PROGRAMME (1901).

The balances used in the Wrights' wind tunnel were ingeniously contrived in such a way that the fundamentally important requirements of obtaining readings that could be translated directly into effective forces upon a full-scale flying machine were given by direct readings, having reduced their critical assumptions to one. This was that the order of merit of the various shaped aerofoils would not be seriously affected by the Reynolds

Fig. 2.

REPRODUCTION FROM ORIGINAL PLOTS OF DATA (1901).

number of the experiment, although the absolute value of the coefficients would change. An actual case is worthy of mention in this respect. The Wright brothers, combining wind tunnel results and flight tests on their 1902 glider, found that the unit drag of a square flat plate was equal to the square of the speed, in miles per hour, multiplied by the coefficient 0·0033. To-day, after considerable research directed upon this question, the figure generally adopted is 0·00328, a truly astonishing agreement.

Fig. 2 shows some results from the models 7, 8 and 9 in Fig. 1, and the familiar shape of the lift and drag curves are such that they might well apply to many aerofoil forms in use to-day.

Dr. Lewis then devoted the main part of his lecture to a description of the recent additions to the U.S.A. wind tunnels at Langley Field, the principal research station of the National Advisory Committee for Aeronautics. The general trend of improvements has been that of increase of size to allow the use of larger models, higher speed of the air stream to keep up with the increase of performance of actual aircraft, and provision for investigations at larger Reynolds numbers by the use of compressed air. Principally, the recent tunnels have been constructed with the definite object of solving the problems that arise in aeroplane design. The most outstanding of these are, the variable density wind tunnel for research at high Reynolds numbers, the 20-ft. propeller research tunnel, the full-scale tunnel, the high-speed jet tunnel for aerofoil research under propeller operating conditions, and an 8-ft. 500 miles per hour wind tunnel. The most recent tunnel, designed in 1937, and now being placed in operation, is shown in Fig. 3. This has a throat diameter of 19 ft., being able to accommodate large-scale models, and works up to speeds of 250 miles per hour at pressures from sub-atmospheric to several atmospheres.

There is a general trend towards the use of dynamic models for the investigation of stability and control problems, based on principles adopted originally by the Aeronautical Research Committee in Great Britain at Farnborough. Also certain classes of investigations are tending towards methods, developed by Prof. B. M. Jones in England and Dryden and Jacobs in the United States, of carrying out fundamental research and applying the results by valid theoretical methods to the prediction of aircraft characteristics.

The most highly specialized piece of equipment yet constructed is the low-turbulence wind tunnel, designed in accordance with Eastman Jacobs' suggestions, and completed in the spring of 1938. Turbulence and velocity fluctuation in the air stream of wind tunnels have long been a matter of concern in this work, but a helpful simplification is obtained from the generally accepted concept that turbulence in the atmosphere is of such a nature that, in free flight conditions, its effect upon the transition from laminar to turbulent flow in the boundary layer is negligible. Tests in smoke tunnels, as well as G. I. Taylor's theoretical work, suggested that in low-turbulence conditions the transition point on an aerofoil might tend to

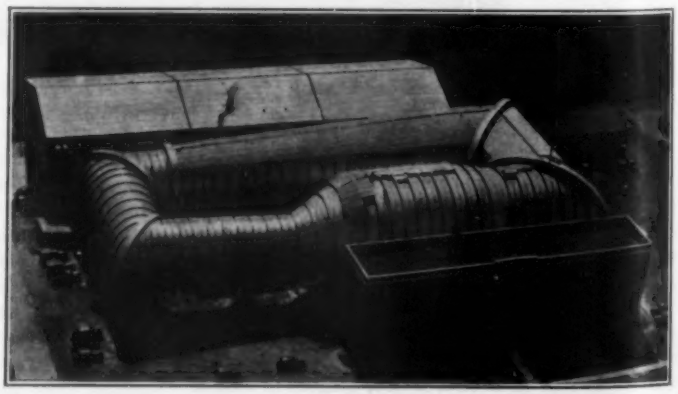

Fig. 3.

THE N.A.C.A. 19-FOOT PRESSURE TUNNEL.

remain in a constant position rather than to move forward, as it does in turbulent wind tunnels, and thus an aerofoil could be designed to take advantage of true low-drag laminar boundary layers over a major portion of its surface. It is claimed that aerofoils so designed and tested in the low-turbulence wind tunnel are showing spectacular drag reduction, which should give valuable increases in speed, range, and general efficiency of aircraft.

Another problem that has been giving increasing concern to aircraft designers is that of the dynamic loading upon the structure due to accelerations consequent upon encountering atmospheric gusts. Increase in size and speed of the aeroplane both accentuate this problem, and it is becoming obviously necessary to establish criteria for design against gust loads. The problem has been approached from two aspects. An instrument, known as the N.A.C.A. V-G recorder, was designed and installed in a number of machines, the total flying time of which, to date, approximates to 67,300 aeroplane hours or 10 million miles, under as widely varying conditions of topography, weather, etc., as possible. The instrument is self-recording, needs no attention from the aircraft's crew, and gives a simultaneous recording of accelerations and air speeds. Statistical results from these instruments suggest a probable maximum effective gust velocity of about 30 feet per second for an aeroplane of the large flying boat type.

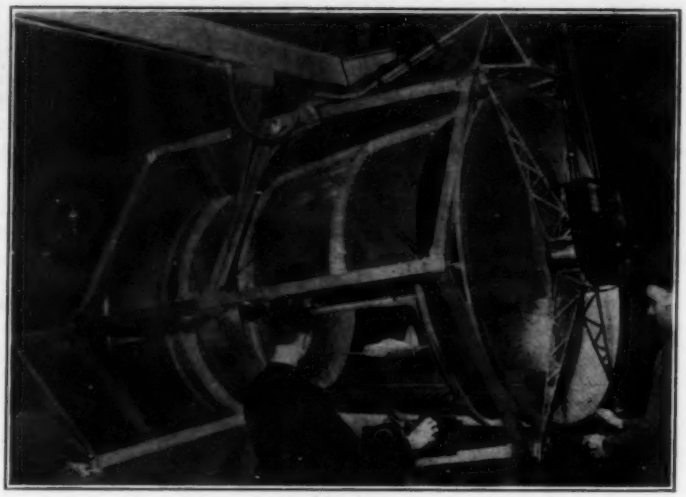

Fig. 5.

THE N.A.C.A. 5-FOOT FREE-FLIGHT TUNNEL IN OPERATION.

Upon this assumption, a 'gust tunnel' has been built in which it is possible to determine experimentally the reaction of suitably scaled dynamic models. It consists of an expanding rectangular channel discharging a controlled current of air in an upward direction, see Fig. 4. A weight-driven catapult launches the model into a free glide at constant speed, and when it enters the air jet it moves according to the changing forces imposed upon it. These movements are recorded photographically by light from small lamps at the nose and tail, and from these the movements of the centre of gravity and the pitching motion can be estimated. An accelerometer inside the model is synchronized with the photographic mechanism, so that the two records can be correlated.

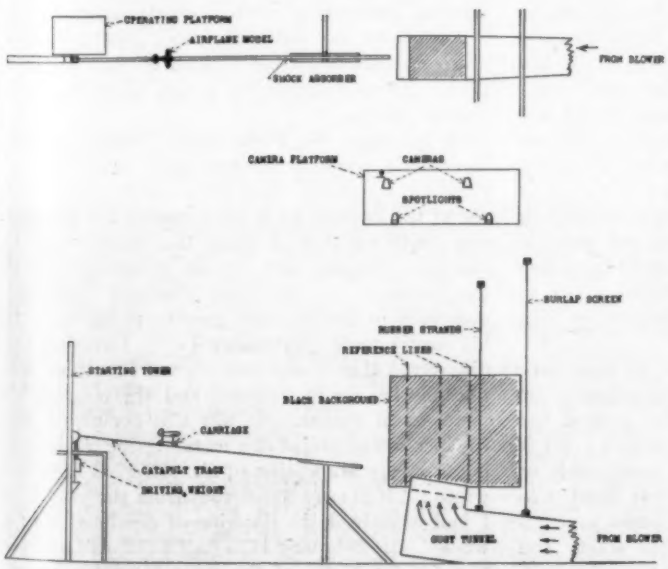

Fig. 4.

DIAGRAM OF THE GUST TUNNEL OF THE NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS.

The general problem of stability and control in flight is also being dealt with in a more precise manner than hitherto by means of a free-flight wind tunnel. The body of the tunnel is 5 ft. in

diameter, provided with a normal fan giving air speeds up to 25 ft. per second. It is suspended on trunnions so that its inclination can be varied, and an operator maintains the inclination and air speed in proper co-ordination with the gliding characteristics of the model under test. A second operator manipulates the controls of the model, governed by small electro-magnets inside its body, by a series of switches connected to the model by a fine wire of length sufficient to hang slack and allow the model to perform any manœuvre unrestricted. Fig. 5 shows this tunnel with a model in free flight inside it.

PRIESTLEY AND LAVOISIER

TWO lectures delivered by Sir Philip Hartog at University College, London, on May 9 and 16 dealt with "The Newer Views on Priestley and Lavoisier", these being given under the scheme for advanced lectures of the University of London.

It was pointed out that the usual estimates of Priestley's work are based on too little acquaintance with his writings, and do not do him sufficient justice. The work of Lavoisier is now better understood, largely by reason of the publications of the late Dr. A. N. Meldrum, and Sir Philip was concerned with some aspects of the relations between Priestley and Lavoisier.

Priestley's early work on electricity is contained in his "History of Electricity", first published in 1767 and written in a year. This shows him making quantitative experiments and putting forward hypotheses which Sir Philip Hartog thinks were based on what Priestley calls the "bold eccentric thoughts of the Queries in the Opticks" of Newton. Priestley's first thoughts on chemistry are also to be found in this book, and in it he describes some experiments on mephitic air and charcoal, the mephitic air being made by passing air over heated charcoal. After finding that a candle would not burn in air that had passed through a charcoal fire, or through the lungs of animals, Priestley says: "I was considering what kind of change it underwent, by passing through the fire, or through the lungs, etc., and whether it was not possible to restore it to its original state, by some operation or mixture". This early work provides a key to Priestley's later studies on gases, beginning with those published in 1772.

When Priestley began his work, there were three special pitfalls into which an investigator on gases could stumble, as well as the general bar to progress set by the phlogiston theory: (1) it was not known whether heat was ponderable or not, (2) it was not known whether light was ponderable or not, (3) permanent gases were regarded as essentially different from solids and liquids. Hales, in his "Vegetable Staticks" (1727), had failed to differentiate gases from air, and although Boerhaave in his "Elements of Chemistry" (1731) speaks as though he distinguished between the different varieties of air—including van Helmont's *gas sylvestre* (carbon dioxide)—yet it was Black and Cavendish, in 1756 and 1766 respectively, who sharply differentiated fixed air (carbon dioxide) and inflammable air (hydrogen). Priestley discovered a number of new 'airs', some of which he collected over mercury, and his publications on these begin in 1772. The airs discovered by Priestley were stated by Sir Philip to be: hydrogen chloride, nitrogen, nitric oxide, nitrous oxide, nitrogen peroxide (which he collected by downward displacement), ammonia, sulphur dioxide, silicon fluoride, oxygen and hydrogen sulphide, all discovered in the period 1772–1790. After his long paper in the *Philosophical Transactions* in 1772, Priestley published his work on gases in his books: "Experiments and Observations on Different Kinds of Air" (3 vols., 1774–77), "Experiments and Observations relating to various branches of Natural Philosophy with a continuation of the Observations on Air" (3 vols., 1779–86), and "Experiments and Observations on Air" (3 vols., 1790). These volumes are a rich mine of experimental results.

Of Lavoisier, Sir Philip said: "From the first Lavoisier's work is distinguished from that of Priestley and many other predecessors, not by the use of the balance as is often stated, for Priestley was quite capable of using the balance and to excellent purpose, but by the systematic use of the balance in checking chemical reactions, especially in dealing with gaseous reactions". In his earlier work (November 1772), Lavoisier had discovered that in the combustion of sulphur and phosphorus, air is absorbed and the combustible increases in weight. He was also persuaded that the increase of weight of a metal during calcination is caused by absorption of air. In 1792 Lavoisier wrote: "It is easy to see that from the year 1772 I had conceived the doctrine of combustion as a whole". In February 1773 (not 1772, as Lavoisier himself, by a slip of the pen, dated his memorandum), he proposed to make a long series of experiments on gases, and in his "Opuscules

physiques et chimiques" in 1774 he fulfils this promise, both in regard to a history of the subject and a new series of investigations. In 1774 he had suspected that it is some *constituent* of the air, not the whole air, which is concerned in combustion and calcination. Although Priestley had prepared a specimen of oxygen on August 1, 1774, by heating red precipitate of mercury, and observed the brilliant combustion of a candle in the gas, Sir Philip Hartog claims that the true date of Priestley's discovery of oxygen was April 1, 1775. Previous to this, Priestley had not distinguished the gas from nitrous oxide, and the crucial test distinguishing the two gases, namely, the action of nitric oxide gas, was not applied by Priestley until March 1775, and in April he speaks of oxygen as "an air five or six times as good as common air".

Priestley met Lavoisier in Paris in October 1774 and spoke of his preliminary experiments to Lavoisier and others. Lavoisier began to work on red precipitate in November 1774, and in February to March 1775 he made experiments which he communicated to the Academy of Sciences on April 26, 1775, the title of the paper (printed in its first state in the May number of Rozier's "Observations sur la Physique") being: "On the Nature of the Principle that Unites with Metals During their Calcination and Increases their Weight". Although Priestley had found by the nitric oxide test that the new gas (oxygen) was five times as good as common air, Lavoisier failed in this experiment and reached the erroneous conclusion that the new gas "is not one of the constituent parts of the air . . . but is the air itself, entire, unchanged, undecomposed". Lavoisier's correct interpretation of combustion and calcination was, in fact, not put forward until March 1777, when for the first time he clearly distinguished between the two constituents of atmospheric air, although his estimate of the relative proportions is again less accurate than Priestley's. Although Lavoisier does not mention Priestley in this paper, Sir Philip pointed out that he does so in other papers, and he regards the suggestion that Lavoisier made no acknowledgment to Priestley as "pure fiction". Lavoisier's important memoirs on combustion in general (1777), on caloric (with Laplace, 1783), and his "Reflections on Phlogiston" (1786) in which he definitely rejects the phlogiston theory, were dealt with by Sir Philip.

Priestley's views on phlogiston were of a very varying character. Sir Philip Hartog directed attention to a remarkable quantitative experiment made by Priestley in 1785. He calcined iron with a burning glass in oxygen standing over mercury, and showed that the weight gained by the iron is equal to the weight lost by the gas. He then reduced the oxide of iron by means of hydrogen and showed that the two processes can be repeated indefinitely, that the volumes of hydrogen and oxygen involved are as 2 to 1, and that the ratio of the loss of weight of the iron oxide to the weight of water formed is as 15 to 17 (actually it is 16 to 18). Although he very nearly adopted the correct explanation, Priestley says he "was taught by Mr. Watt to correct this hypothesis and to account for this result in a different manner". As Sir Philip said: "Priestley henceforward displays what seems to us almost a perverse ingenuity in adapting the phlogiston theory to fit every new fact". The later developments of the phlogiston theory have recently been studied in the publications of Partington and McKie in the *Annals of Science*, and it seems as if Priestley had been on the point of escaping from this maze but was induced to penetrate still further into it by following the lead of James Watt.

Lavoisier first enunciated his own views as a body of doctrine in his classical "Traité Elémentaire de Chimie" in 1789, a work which, according to McKie, marks the foundation of modern chemistry as securely as Newton's "Principia" marked the foundation of modern mechanics. In this book, Lavoisier lays down certain general principles of scientific method, which he had mostly taken from Condillac. Priestley had, in his earlier work, been guided by Franklin and he says: "Every experiment in which there is design, is made to ascertain some hypothesis. For an hypothesis is nothing more than a preconceived idea of an event. . . . An hypothesis absolutely verified ceases to be termed such, and is considered as a fact." Thus, science is to be reduced to a statement of all the facts in the smallest compass and the hypotheses finally disappear.

In concluding his lectures, Sir Philip said: "It may be said of Priestley and of Lavoisier individually that where a generation of chemists had been blind those two men saw. Yet neither of them was impeccable. And they had far more in common, both in their successes and their failures, than has been generally recognized, though ultimately Lavoisier outdistanced Priestley. By a combination of their discoveries Lavoisier effected a transformation of chemistry and a revelation of some of the most fundamental processes of vegetable and animal life". Although we are told that the old foundations of scientific thought are now being broken up, yet "at that earlier turning point, a century and a half ago, the pattern imagined by Lavoisier, in part with elements supplied by Priestley, was a great pattern, which served a great purpose. It multiplied man's control of external nature a thousandfold; and in itself was a vision of beauty".

OBITUARIES

Baron Joji Sakurai

ON January 28 of this year there passed away from this world, at the ripe age of eighty years, Prof. Baron Joji Sakurai, the great promoter of scientific research in Japan, ardent lover of peace and friendship among men, and one of the finest spirits and greatest gentlemen of this or any age. Proud indeed must be his homeland to have produced one who was honoured, respected, and beloved by men of science of many nations, and proud are we in England to have had him in our care during his formative years of study at University College, London (1876–1881). No one who had the privilege of meeting him ever failed to be deeply impressed and strongly attracted by his quiet dignity, his gentle and endearing modesty, and the warm glow of friendliness and high intelligence that shone from his eyes and suffused his every word. Throughout a long and laborious life he strove with a total disregard of self to make his fellow-countrymen strong and healthy in mind and body by the light of reason and science, to promote their peaceful, cultural relations with men of other lands, and to build up an amity of nations, founded on mutual co-operation directed to the high goal of a civilization, purified from ignorance and prejudice and illumined by a great hope. So lived and died this great and good man that came from the East, and was the friend of all men of goodwill throughout the world.

Joji Sakurai

Joji Sakurai was born in Kanazawa (Province of Kaga) on August 18, 1858. He went to Tokyo in 1871 and studied chemistry under R. W. Atkinson at the Kaisei Gakko, a forerunner of the University of Tokyo. At the request of the Japanese Government, Atkinson had been sent to teach chemistry at Tokyo by Prof. Alexander W. Williamson, of University College, London. Williamson had early interested himself in the welfare of Japan, especially in the education of young Japanese students in England, among whom were the celebrated Prince Ito and Marquis Inoue. In 1876 young Sakurai was sent by his Government to prosecute the study of chemistry in England, and entered University College in October of that year. He studied chemistry under Prof. Williamson, physics under Prof. Carey Foster and Dr. Oliver Lodge, mineralogy under Prof. G. Morris, and hygiene under Prof. W. H. Corfield. At the end of his first year he won the gold medal for chemistry, and a year later the Clothworkers' Scholarship for proficiency in chemistry and physics. Under the guidance of Williamson, Sakurai began an interesting research on metallic compounds containing bivalent hydrocarbon radicals, which was continued after his return to Japan and resulted in three papers communicated to the *Journal of the Chemical Society* in the years 1880, 1881, and 1882. In 1885 he obtained methylene chloro-iodide, a sign that his interest in organic chemistry still continued.

In September 1881 Sakurai returned to his native country and was immediately appointed lecturer in chemistry in the University of Tokyo. In the following year he became professor at the early age of twenty-four years. As time went on, he became deeply impressed with the importance of the new physical chemistry associated with the names of Raoult, Le Chatelier, Arrhenius, van't Hoff, Ostwald and Nernst. By his example and his teaching he exercised a profound influence on the direction of chemical studies in Japan, and became indeed the founder of scientific chemistry in that country. His important modification of Beckmann's boiling-point method for determining the molecular weights of substances in solution, an account of which appeared in 1892 in the *Journal of the Chemical Society*, was a notable contribution to the practical side of physical chemistry, whilst his work on the molecular conductivity of amidosulphonic acid (*J. Chem. Soc.*, 1896) had an important bearing on the problems of molecular structure and the influence of substituent groups. In this connexion, mention must also be made of his allied investigations on the constitution of glycocoll and its derivatives, in which he brought forward evidence for the ring- as against the usually accepted chain-structure.

Sakurai was the founder of a great school of chemical research in Japan, many of his pupils, for

example, Ikeda, Osaka, and Matsubara, becoming themselves university professors and leaders of chemical research. He retired from his University professorship in 1919, having served the cause of science and education for nearly forty years, not only as inspiring teacher and investigator, but also as University councillor, dean of the Faculty of Science, and acting president of the University (elected honorary professor soon after his retiral).

It is not possible to exaggerate the importance of the work which Sakurai did in promoting the establishment and development of great organizations for scientific research in Japan. Indeed, it is only fair to say that the eminent position which that country occupies to-day in the world of pure and applied science is largely due to his initiative, energy, and foresight. Having been for more than thirty years before the outbreak of the Great War one of the most active members of the Tokyo Chemical Society, of which he was several times elected president, the events of 1914–18 convinced him (and others in Japan) that a great development of scientific research was necessary for the well-being, prosperity and safety of that country. The first result of these efforts was the establishment in 1917 of the important "Institute of Physical and Chemical Research". Not content with this great success, Sakurai, with his colleagues and friends, worked for many years for the establishment of a national organization of much wider scope, which would have for its main object the promotion of research in *all* branches of science. The final result was that, backed by the influence and a splendid gift of H.M. the Emperor, and provided with an ample subsidy voted by the two Houses of the Imperial Diet, the Japanese Society for the Promotion of Scientific Research, with H.I.H. Prince Chichibu as patron, Viscount Saito (then premier) as president, and Prof. Sakurai as chairman of the Board of Directors, came into existence in 1933.

The labours involved in the accomplishment of these great designs by no means exhaust all that Sakurai did for his country and for science. He was elected president of the National Research Council of Japan soon after the international conferences held in 1918 in London and Paris, and retained this position until his death. He attended, as the leader of the Japanese delegation, the second Pan-Pacific Science Congress, held in Australia in 1923, and at the third Congress, in Tokyo in 1926, prepared, as chairman of the International Committee, a draft constitution and by-laws for the permanent organization of the Congress. These were adopted with only slight verbal alterations, and the Pan-Pacific Science Association came into existence.

Prof. Sakurai attended, as the scientific representative of his country, very many international meetings and congresses. His dignified bearing, clear-sighted wisdom, and charming personality became in this way widely known to men of science of many nations. He was twice elected a vice-president of the International Chemical Union, namely, in 1923 and 1928, and at the third general assembly of the International Council of Scientific Unions (London, 1937), was elected a vice-president, filling the vacancy created by the death of Marconi.

Many honours came to Sakurai from foreign countries. Thus he received the honorary degree of LL.D. from the University of Glasgow in 1901, and was elected an honorary member of the Chemical Society of France, the Society of Chemical Industry, the Royal Institution of Great Britain, the American Chemical Society, the Academy of Sciences of the U.S.S.R., and the Chemical Society of Poland. In 1931 he was elected an honorary fellow of the Chemical Society, and in 1937 an honorary fellow of University College, London. This very high distinction from his old *alma mater* gave him particular pleasure.

It was natural and just that the great and meritorious services which he rendered to his country were signalized by distinguished honours: Order of the First Class of the Sacred Treasure (1916); appointed by the throne a member of the House of Peers (1920) and Privy Councillor (1926); Grand Cordon of the Rising Sun (1929). Shortly before his death he received the Grand Cordon of the Rising Sun and Paulownia, and was created a baron*.

Owing to the old connexion of University College, London, with Prof. Sakurai and with the development of the Empire of Japan as one of the scientific great powers of the world, I had the privilege of welcoming to the Chemical Department of University College a number of Japanese men of science, including many Ramsay Scholars, amongst whom may be mentioned K. Matsuno, K. Suzuki, R. Azuma, H. Tsukamoto, Y. Hori, N. Kameyama, K. Kodama, R. Sato, S. Takagi, Y. Yamaguchi, M. Emi, R. Shinoda, Y. Nagai, T. Somiya, I. Sawai, R. Tsuchida, R. Matsuda, N. Ando, and H. Oosaka. The pleasant and friendly association with these young men, many if not all of whom now occupy important positions in their own country, was a very happy experience in my life; and to have been able to contribute to the preservation of a long and faithful friendship an especial joy.

The name of Joji Sakurai will live in the history of science and civilization. As a great patriot, his name will shine in the history of his country. Joji Sakurai, the man, lives as a fragrant memory in the minds of his host of friends. F. G. DONNAN.

* I am deeply indebted to Prof. Koichi Matsubara for much of the biographical information embodied in this notice.

Prof. M. V. Shuleikin

SOVIET science has suffered a great loss in the death on July 17 of Prof. M. V. Shuleikin, member of the Academy of Sciences of the U.S.S.R. and chief engineer of the Department of Communications of the Red Army.

Prof. Shuleiken spent thirty years of strenuous work in the preparation of numerous scientific workers in the field of radio-communications and in the development of Soviet radio-technics. He commenced his scientific and teaching career in 1908 after graduating from the St. Petersburg Polytechnical Institute. Soon after the Revolution he

removed to Moscow, where he worked in the Red Army on the development of military communications. As a result of this work he was successful in solving many complex problems; he produced numerous valuable works dealing with the strengthening of the country's defence capacity. At the same time, Prof. Shuleikin was engaged in extensive educational work. He gave all the principal courses in radio-technics at the former Moscow Higher Technical School, at the Military Electro-Technical Academy, at the Institute of National Economy and at the Moscow Electro-Technical Institute of Communications.

The last six years of Prof. Shuleikin's activities were closely connected with the Academy of Sciences of the U.S.S.R. In 1933 he organized the work at the Academy relating to electro-communications. Under his guidance this work helped to solve a number of problems connected with the diffusion of radio waves, the maintenance of regular communications on the main radio services, and also the adoption of measures to combat magnetic storms.

Prof. Shuleiken was elected a member of the Academy of Sciences of the U.S.S.R. at the beginning of this year. He threw himself with still greater energy into the work of solving the complex problems relating to modern radio-technics and the working out of material for a general plan of development of communications in the Third Five-Year Plan. He also took part in the building of the Palace of Soviets in Moscow, in the capacity of chief consultant on questions relating to communications.

Mr. F. W. Jones, O.B.E.

MR. F. W. JONES, well known for his work in small-arm ballistics, died at a London nursing home on June 25. He was a native of Nottingham but received his training (1887–89) at the Royal College of Science, South Kensington. On leaving college, he joined Colonel Schultze's factory in the New Forest, where the first smokeless shotgun powder, 'Schultze granulated gunpowder', was in its initial stage of development. Within two years, Jones became the manager of the factory and he was thus one of the earliest pioneers of the smokeless powder industry.

Shortly afterwards, Jones joined the Smokeless Powder Company, Ltd., at the works at Barwick, Hertfordshire, and in the following year became works manager. At this factory colloidal nitrocellulose powders were first manufactured in Great Britain, and a wide series of 'rifleites' was prepared for military and sporting use. In 1898, Jones was the principal witness for the defence in a long and important action brought by Heidemann against the Company for infringement. Although the Company won the action, it was crippled financially and soon passed into liquidation.

Jones then became a consultant on explosives. His early clients included Eley Bros., New Explosives Co., Ltd., Cogswell and Harrison, and the *Field* newspaper, and he was also 'proof master' to the London Proof House. At this time he advanced considerably the science of ballistics, both in rifles and shotguns, and published many articles on this subject in *Arms and Explosives*. A large portion of his work was incorporated in the "Service Textbook of 1929" and justifies his title as the greatest small arms ballistician in Great Britain.

Jones was not only pre-eminent in the theory of rifle shooting, but also at the target, using the match rifle. At his first visit to Bisley some twenty-eight years ago, he was the winner of the aggregates, only to lose the prize because the barrel of his Ross rifle was slightly overweight. His successes at Bisley have continued regularly ever since, and last year, at seventy-one years of age, he won the first three of the match rifle competitions. He was generally one of the first selections for the English team. He worked indefatigably after the Great War for the production of a British military cartridge firing nitrocellulose powder and a streamline bullet, and he lived just long enough to see this cartridge, largely the result of his own personal labours, adopted by the British Government. His successes at Bisley were most popular, since his advice and great experience were always at the service of those who desired them.

During the Great War, Jones rendered assistance to the Ministry of Munitions in the large field of experimental and research work found necessary in meeting ever-changing war conditions. Development of caps and tracer and armour-piercing rifle bullets were some of the most important items.

After the War, on the concentration in Imperial Chemical Industries of the manufacture of powder and ammunition, Jones was appointed technical adviser, and his services were invaluable in assisting the improvements and developments in powder and cartridges.

WE regret to announce the following deaths:

Dr. Vladimir Brandstätter, who has collaborated with Prof. Absolon, curator of the Moravian Museum, in extensive local archæological excavations, on July 18, aged forty years.

Dr. Alfred Harker, F.R.S., emeritus reader in petrology in the University of Cambridge, on July 28, aged eighty years.

Prof. W. P. Lombard, emeritus professor of physiology in the University of Michigan, on July 13, aged eighty-four years.

Prof. J. H. McFadden, assistant professor of psychology in the University of Pittsburgh, on May 28, aged forty years.

Dr. W. J. Mayo, co-founder with his brother, the late Dr. C. H. Mayo (see NATURE of July 15, p. 103), of the Mayo Clinic, Rochester, Minnesota, on July 28, aged seventy-eight years.

Prof. R. W. Reid, emeritus regius professor of anatomy in the University of Aberdeen, on July 28.

Mr. Scoresby Routledge, known for his investigations among the Akikuyu of East Africa and of the archæology and ethnology of Easter Island, on July 31, in his eightieth year.

NEWS AND VIEWS

Sir George Stapledon, C.B.E., F.R.S.

ALL who are interested in the progress of agricultural science and practice will hear with great satisfaction that the Royal Agricultural Society has awarded its Gold Medal to Sir George Stapledon, professor of agricultural botany and director of the Welsh Plant Breeding Station, Aberystwyth, for his conspicuous services to agriculture. This follows closely on the knighthood recently conferred upon him and on his election into the Royal Society, and the triple recognition of the good work he has long done for agriculture during a very strenuous life is extremely gratifying. Sir George began his agricultural career at Cirencester, where he early became interested in grassland problems and laid the foundations for the special studies that he has since brilliantly developed. When the plant breeding station was established at Aberystwyth he was put in charge of it and commenced work on the breeding and selection of grasses, clovers and oats. He did not confine himself to the experimental fields, but also undertook wider investigations in grassland management which were greatly developed when the magnificent donation of Sir Julien Cahn enabled the College authorities to acquire a hill farm. In the course of his activities, he has visited Australia and New Zealand and studied grass problems there. At present he is making a survey of the grasslands of Great Britain, and those who have read his books will look forward with interest to the account which it may be hoped will be published when his review is complete. His many friends wish him many years of continued fruitful activity.

Dr. David Fairchild

DR. DAVID FAIRCHILD, veteran plant explorer of the United States Department of Agriculture, has been awarded the Meyer Medal of the American Genetic Association for distinguished services in plant introduction at the Glendale, Maryland, Plant Introduction Station of the United States Department of Agriculture. Dr. Fairchild has been associated with the U.S. Department of Agriculture for fifty years. Through his unflagging interest and enthusiasm, hundreds of new plants have been introduced into America. From this work has grown the date industry in California. The soybean, another introduction resulting from Dr. Fairchild's work, is now an industry worth seventy million dollars. Many of the superior cereals now grown on American farms owe their resistance to disease and their ability to withstand unfavourable weather conditions to plant introductions which have been used in breeding work. A most important recent incident in plant introduction has been the saving of the cantaloupe industry in California which was decimated some years ago by a fungus disease, powdery mildew. A wild variety from India, itself of such poor quality as to be scarcely edible, was found to be resistant to the mildew. This resistance has been transferred by applied genetic method to excellent new varieties, also resistant. Dr. Fairchild joined the U.S. Department of Agriculture in July 1889, fifty years ago. He established, and was for many years head of, the office of Foreign Seed and Plant Introduction. During this time he travelled widely through all parts of the world. In 1938 he retired from active service with the Department, but his interest in plants has remained, and in the years following his retirement he has been instrumental in much work with new plants now being carried on in Florida, where he has lived since his retirement.

Prof. Jaroslav Perner

PROF. JAROSLAV PERNER, professor of palæontology in the Charles University, Prague, has recently celebrated his seventieth birthday. He was born at Tynce on the Labe (Elbe) in 1869 and studied zoology and palæontology under Profs. Antonin Frič and Otokar Novák. He acted as assistant and later as keeper of the Geological Department at the National Museum, where his chief work was the arranging of Barrande's collections. After Barrande's death, Prof. Perner continued his great treatise "Systême Silurian du centre de la Bohême". He described the Gastropoda of the formations included in the system, in three quarto volumes, during the years 1903–1911. Before this, Perner had published four volumes of his important treatise "Études sur les Graptolites de la Bohême" (in Czech) wherein he corrected the old and incorrect accounts of this fauna and laid the basis for the modern stratigraphic division of the Lower Palæozoic rocks of Bohemia. After the death of Prof. E. Koken of Tübingen in 1912, the Russian Imperial Academy of Science at St. Petersburg asked Mr. Perner to continue Koken's "Gastropoden des baltischen Untersilurs". This Perner did during 1913–1925. In addition he has written a number of scientific articles on Phyllocarida, trilobites, fishes, conodonts and other fossils of the Palæozoic rocks of his country. These have appeared mainly in the *Journal of the Bohemian Academy of Sciences* or in the *Centralblatt für Geologie*. On the death of Prof. Filip Počta in 1928, Prof. Perner was appointed professor of palæontology in the Charles University, and had control of the palæontological collections at the Geological Institute (under Prof. Radim Kettner). He obtained part of the great Hanus collection, which contained much new and rare material. A new development of his subject has taken place since his appointment, which can be seen from the published work of his pupils. He is a corresponding member of the Palæontological Society of Washington, a member of the Bohemian Academy of Arts and Sciences, and an honorary member of the Bohemian Royal Society of Sciences.

Close Approach of Mars

MARS was in opposition with the sun on July 23, and was nearest the earth, at a distance of 36 million miles and with an angular diameter of 24·1″, on July 28. Despite the closeness of the approach, the apparition is a most unfavourable one for observation in high northern latitudes. This is because of the planet's very large south declination. In May its declination ranged between $-22\frac{1}{2}°$ and $-23°$; by the end of June it increased to $-24°$; and it is now $-27°$. Thus, since observations began, the altitude above the horizon in the latitude of Greenwich has never exceeded 16° and is now less than 12°. It follows that observers in Great Britain and in most northern observatories cannot expect to get good views of the planet during the present apparition. We shall have to rely almost entirely for our results on observers in the southern hemisphere. Astronomers in northern latitudes may look forward confidently to the next apparition in 1941; for then the planet will be high in their skies and not very much farther away from the earth. During the present apparition, the southern hemisphere of Mars is tilted towards the earth, the latitude of the centre of the disk being $-12°$ at the beginning of June and $-7°$ at the end of August. The spring equinox of Mars' southern hemisphere occurred on June 1; the summer solstice will occur on October 24.

IN addition to the disadvantage of the planet's low altitude, English observers have had to contend with exceptionally bad weather conditions. The long spell of unsettled weather has brought with it very poor definition, which is, of course, greatly exaggerated when observations have to be made near the horizon. On the few clear nights available, Mars has generally resembled a pulsating ball of wool; and only on rare occasions, and then for brief intervals, has the disk been steady enough for the more prominent features to be made out. The south polar cap which up to the beginning of July was large is now starting to melt rapidly. The southern *maria* have in general appeared fairly dark and many of the lighter regions situated in their midst have appeared shaded over. This phenomenon has been particularly striking in certain regions. Thus the Rev. T. E. R. Phillips observed Hellas deeply shaded; and during the last two weeks Dr. R. L. Waterfield found the region *south following* the *Solis Lacus* to be much darker than usual. But the *Solis Lacus* itself, so far as one could see, presented its normal configuration, and had not undergone any such striking metamorphosis as it presented in 1926 and 1928. There have been remarkable whitenesses towards the north polar regions, which about July 10 and July 30 were almost as dazzling as the southern snow cap. These may be due to cloud, although their brilliance suggests that they are snow; but if they are due to snow, they are probably not part of the pole-cap proper, as they are situated very eccentrically with regard to the north pole itself. It is gratifying to hear that Dr. V. M. Slipher of the Lowell Observatory has gone to Bloemfontein to observe the planet. So far, no official reports have come to hand; but according to brief reports in the Press he has already detected some interesting changes in the *Solis Lacus* region, which are possibly those referred to above.

Official Tests of 'Anderson' Shelters

A SERIES of official tests was recently carried out on the 'Anderson' air raid shelter, and the results published. The A.R.P. Co-ordinating Committee, which is an independent body of architects, surveyors, medical men and men of science under the chairmanship of Prof. J. B. S. Haldane, has made some serious criticisms of these tests in a statement forwarded to Sir John Anderson. The Committee admits that a certain amount of useful information has been obtained, but it considers that insufficient tests were carried out to justify what it calls 'far too optimistic' conclusions. A number of interesting points are raised; for example, the Committee thinks that it is not enough to do each explosion test once only; and if, as is claimed, apparently similar bombs often behave differently in exploding, the objection would seem to be justified. The Committee also asks for further research into the physiological effects of blast, a subject which is very imperfectly understood. It is well known that 'blast' is, in effect, a very rapid rise in pressure followed by a slightly slower fall. It is this *rapid* fluctuation of pressure, presumably, which gives blast its lethal effect. The Committee rightly points out that there is strong evidence that it is not the *magnitude* of the changes in pressure which matters so much as the rate at which the pressure changes. The reactions of the human body to fairly slow changes of pressure have long been well known to physiologists, but there is little exact knowledge of the results to be expected when the body is subjected to wide fluctuations in a fraction of a second. If, as we are told, the general population is to be exposed to just such changes, the Committee would seem to be justified in calling for more research.

THE Committee's statement raises the further point that the tests indicate that in many London boroughs the population, if sheltered entirely in Anderson shelters, might be expected to suffer approximately seventeen casualties per ton of bombs dropped, and says, "When it is borne in mind that the President of the Air Raid Protection Institute estimated in March 1939, that Germany alone could despatch 3,000 tons of bombs per day to this country, the seriousness of the position will be apparent". The Committee urges that this is further reinforcement for the case for a scheme of heavily protected shelters, particularly in fairly densely populated areas, and argues that if the tests had preceded the adoption of the official shelter policy a different policy might well have been adopted.

Saxon Time Measurement

IN making a clearance of earth during alterations to the Cloister Garth at Canterbury Cathedral a Saxon pocket sun-dial, or time-piece, of gold and silver was found recently at a depth of two feet below the surface. It is described (*The Times*, July 31) as being in the form of a tablet of silver with a gold

cap and chain, and for gnomon a gold pin surmounted by a delicately chased animal head, with jewelled eyes and a ball in its mouth. This pin, when not in use, rested in a hole at the lower end of the tablet, and was in this position when the time-piece was found. On the faces of the tablet are inscribed the names of the months, abbreviated and in pairs. At the top of each of the three columns is a hole for the pin when in use, and below each hole two spots. Of these the higher in each month, when the dial hangs free, indicates noon and the lower 9 a.m. and 3 p.m. marking the hours of the monks' services. Along the edges runs the inscription: *Pax Possessori—Salus Factori*. The dial has been tested for accuracy by Dr. A. H. Smith of University College, London. The grouping of the months in pairs according to their equivalent distances from the summer solstice is based, it is to be presumed, on the table given by Bede for measuring the shadow of a six-foot gnomon. Dr. Smith finds that owing to its small size, the dial could only be approximately accurate. It would, however, be more or less correct at noon in latitude 53° N. at the middle of certain months, or early in others, while in the far north of England it would be more or less accurate through the summer months. At 9 a.m. and 3 p.m. it would be more or less accurate in late January, mid-February, mid-March, early April, early May, late July, mid-September, early October, early November and early December.

Anglo-Saxon Ship Burial

SHIP BURIALS are of sufficient rarity, even on the Continent, for the discovery of an Anglo-Saxon ship burial at Sutton Hoo, near Ipswich (*The Times*, July 26, July 31) to be regarded as a memorable and, indeed, remarkable event. This is, in fact, only the second of the kind to be found in England, a previous discovery, though of a rather less impressive character, having been made at Snape, two miles away. In the present instance, the vessel in which the interment had taken place was a rowing galley 82 ft. long. The quantity and character of the jewellery and other personal objects associated with the burial were such as to justify the assumption that a chief lay buried here. The personal relics were found collected together in the centre of the ship, and included a handsome gold buckle, clasps and fastenings of the garments, gold studs from a belt, and small plaques of gold bearing figures of human beings and animals. The sword had been laid by the side of the body; but it has almost entirely perished, with the exception of the richly ornamented gold and jewelled pommel. The deceased had also been provided with money, the remains of a purse being found beside some coins. Other articles found with the burial were iron pots and spearheads, and an object which has the appearance of a sceptre, having faces carved at either end. A metal cup may, it is thought, have contained some articles of symbolic significance. The grave is situated on the estate of Mrs. E. M. Pretty, and has been excavated by the authorities of the Ipswich Museum, under the field direction of Mr. Guy Maynard, with the co-operation of H.M. Office of Works and the British Museum.

Lightning Flashes and High Tension Mains

DURING July there were many violent thunderstorms and much damage was done to overhead electric mains and substations connected with them. The damage done to main stations was also severe. On July 19, a violent thunderstorm cut off Valley Road Power Station at Bradford from the Grid and shut down all the generating sets there. For about an hour, mills, factories, trams and trolley-buses on many routes came to a standstill; the traffic lights failed and there was no light anywhere for about an hour. A similar occurrence took place at the Brighton Power House at Southwick. In both cases the difficulties of the staff were increased as they were engaged in changing over on the Grid supply from 6·6 kilovolt to 33 kilovolt. There was a heavy storm over Cumberland and the overhead transmission was struck. This affected the supply to more than 30,000 houses in Cockermouth, Maryport, Aspatria and Wigton as well as part of Workington, the lights being out from 3.15 p.m. to 8.30 p.m. On July 19, at 8 p.m., the B.B.C. National Transmitter at Droitwich was struck by lightning and put out of action. The flashes striking the 700-ft. masts of the Radio Station were extremely violent. Flames shot from the cage of aerial wires slung between the masts. In some places transformers or switchgear were damaged and three fires broke out, destroying substation roofs or walls. Since thunderstorms are less frequent in Great Britain than in South Africa and other parts of the world it might be useful to study the effects of modern lightning protectors in protecting poles, steel towers, overhead mains, etc., in places where thunderstorms are frequent and violent. Also when designing new grids or extensions of old ones to get estimates of the relative costs of overhead mains and of underground mains. A decision could then be arrived at as to which is the better method of transmitting high-tension electric power.

Empire Broadcasts on Scientific Topics

THE British Broadcasting Corporation has instituted a short series of quarter-hour broadcasts to the Empire on recent advances in science. The first talk of the series was given at 11.15 p.m. on July 31 by Prof. Allan Ferguson, one of the general secretaries of the British Association. Prof. Ferguson, after giving a simple picture of the structure of the atom, and the results to be expected from atomic bombardment, described briefly the development of the cyclotron, recent experiments on nuclear disintegration, including the uranium-fission experiments, and the production of 'labelled' particles. Succeeding talks will be given by Wing-Commander Cave-Browne-Cave on mechanical engineering (August 7), by Dr. S. J. F. Philpott on psychology (August 14) and by Prof. F. A. E. Crew on biology (August 21).

League of Nations

"The League from Year to Year (1938)", which has recently been issued by the Information Section of the Secretariat of the League of Nations, contains the usual concise account of the year's activities in

sufficient detail to facilitate careful study of the political, legal and technical work of the various organs of the League of Nations. (Geneva: League of Nations; London: George Allen and Unwin, Ltd., 1939. Pp. 214. 1*s*.). Of special interest to scientific workers are the chapters on intellectual co-operation, the health organization, the communications and transit organization and those on the European conference on rural life and technical collaboration with China. A chapter dealing with refugees is included as well as one on mandates. The detailed chronological table of the principal events in the League's sphere of activity during the year, giving the dates of the meetings of the different organs of the League and of their principal decisions, as well as of world political events affecting the League's work introduced last year for the first time is again a feature of the new edition.

The Colonial Problem

THE proposals of the Labour and Peace movements for dealing with the colonial question are examined in a pamphlet "New Tendencies in Colonial Policy" issued by the Pacifist Research Bureau (New Tendencies in Colonial Policy. With an Introduction by Leonard Barnes. Pp. 16. London: Pacifist Research Bureau, 1939. 2*d*.). It is argued that there are only two alternatives: an extended and rearranged imperialism with new rival imperialisms of greater equality and an ultimate clash between them; or the removal of existing imperialisms and their substitution by a great conception of civilization's responsibility for the so-called uncivilized, with an equally great conception of world economic organization. The necessity of conforming to the wishes, or, at least, obtaining the consent of the native peoples in all matters affecting their welfare is also emphasized, including the application of this principle not only to the mandated territories but also in other colonial questions. The problem is further discussed in another pamphlet issued by the Bureau, "War and the Colonies" (War and the Colonies: a Policy for Socialists and Pacifists. Pp. 16. London: Pacifist Research Bureau, 1939. 2*d*.), in which proposals for a world conference to effect the liquidation of imperialism are briefly outlined.

Language in Science

THE general considerations of linguistics which throw light upon the procedure of science are discussed by L. Bloomfield in the fourth number of volume one of the "International Encyclopedia of Unified Science" (Linguistic Aspects of Science. By Leonard Bloomfield. Pp. viii+60. (Chicago: University of Chicago Press; London: Cambridge University Press, 1939.) 5*s*. net.). If language is taken into account, science can be distinguished from other phases of human activity by agreeing that science shall deal only with events that are accessible in their time and place to any and all observers or only with events that are placed in co-ordinates of time and space, or that science shall employ only such initial statements and predictions as lead to definite handling operations or only terms such as are derivable by strict definition from a set of everyday terms concerning physical happenings.

IT is the task of science to provide a system of responses which are independent of the habits of any person or community, but Mr. Bloomfield points out how far short we are of accurate definition in regard to meanings which are involved in the habits of communities and individuals, since the relevant branches of science are quite undeveloped. Discussing the development of scientific language, he distinguishes between the informal and formal scientific discourse, and emphasizes the importance of defining exactly the meaning of technical terms and limiting their use within the agreements upon which they are based. When meanings of the outside world are admitted, error may be incurred and certainty is lost. With regard to the place of linguistics in the scheme of science Mr. Bloomfield places it between biology and ethnology, sociology and psychology. It stands between physical and cultural anthropology. It is closely related to logic, since it observes how people conduct a certain type of discourse. The critique and theory of scientific speech is the task of logic. Mathematics, however, is a science only so long as we believe that the mathematician is not creating speech-forms and discourses (which is a skill, craft, or art) but exploring an unknown realm of concepts or ideas.

Library Services in the United States

UNDER the title "Professional Library Education" the Office of Education, United States Department of the Interior, has issued a bulletin by Nora E. Beust (*Bull.* No. 23; 1937) describing the present position of library services in the United States and indicating the possibilities it offers as a career, and the qualifications required for the various fields of service. Much that is said of the different types of library such as the public library, the school, the university or the special library is true generally, and if due allowance is made for the different conditions and details in the United States, this pamphlet gives a reasonably sound guide to the possibilities in Great Britain also, even if some directions have been much more developed in the United States. Details regarding training for librarianship, like the figures showing the present status of the profession, relate solely to the United States and attention is directed to a marked growth in the number of librarians in the last three decades, particularly in comparison with the number of practitioners in other professions. Some reasons for success and failure in library work which are set forth in conclusion are of general validity.

The Society of Applied Biologists

PRIOR to the year 1904 there was no scientific society or journal in the United Kingdom devoted to applied biology. There was, moreover, little opportunity or encouragement for research in this field, and the work of the universities and other

educational institutions was primarily concerned with pure science. Owing to the initiative of Mr. W. E. Collinge of the University of Birmingham and others, however, the Society of Applied Biologists (as it is now termed) came into being. And as 1938 marked the publication of the twenty-fifth volume of its journal (*Annals of Applied Biology*), Prof. W. Brierley, joint editor since 1921, has written an interesting account of the development of the Association (*Ann. App. Biol.*, **26**, 178; 1939), correlating it with more general trends of development in the country over the same period of years. From the outset the Society has welcomed all investigators in economic biology, whether agricultural, horticultural, medical or commercial, and since its inception has steadily widened its interests. The journal, too, has increased in scientific value, developing from a volume of 359 pages in 1922 to one of 891 pages in 1938. The inclusion of photographs of the presidents of the Association from 1904 up to the present time adds much to the interest of the retrospect.

Agricultural Research Institutes

THE reports on the work of the agricultural research institutes in the United Kingdom carried out during the year ending September 1936 have now been published (London: H.M. Stationery Office. 5*s*.). The volume also includes reports of a number of other investigations, particularly into animal diseases, set afoot by the Agricultural Research Council, and accounts of the research activities of the agricultural advisory officers. Those who require fuller information on any subject are invited to consult the original papers, a list of which is attached to each report, or to inquire of the director of the institution concerned. Farmers and others in need of advice on agricultural or horticultural matters are reminded that by applying to the agricultural organizer for their county, they can draw direct benefit from these research and advisory services. It is perhaps unfortunate that so much delay occurs before these reports are published, as thereby some of their value is inevitably lost.

"Know Your School" Movement in the United States

To the various agencies which foster local interest in the public schools of the United States, such as the official popular magazine *School Life* and parents' associations, a notable addition has recently been made. At the request of the American Association of University Women, the Office of Education prepared a series of study outlines of certain aspects of the public school system for the use of the Association's branches. These proved so widely acceptable that they are being reprinted as ten-page leaflets. Those already issued are: "Know your Board of Education" (Local Education Authority), "Know your Superintendent", "Know your School Principal" and "Know your Teacher". They deal simply and clearly with such questions as "What are the duties of the principal?", "What should be his qualifications?", "Relationship to the local education authority, to the superintendent, to supervisors, to teachers, to the school janitor, to the community". They are well adapted for guiding discussion by study circles and contain suggestions for investigation and discussion. In an article by the president of the University of Chicago which appeared in *The Times* United States Supplement of June 8, reference is made to "the deep and abiding faith of the people in education", and it concludes—"we shall yet make good our boast that we are giving the world a demonstration of education by and for democracy". The leaflets should serve as an acid test of this faith, and eventually tend to strengthen it.

Manufacture of Rare Gases

IN an article by H. C. A. Holleman on the manufacture of rare gases (*Philips Tech. Rev.*, May), a method is described by which rare gases, as well as oxygen and nitrogen are obtained from the air at the Philips' factories at Eindhoven in Holland. During the Great War, when it became more and more difficult to import the argon necessary for filling the incandescent lamps made in the factory, they were forced to manufacture the gas itself and a gas liquefaction plant was installed. This plant continued to grow steadily after the War, as it was found to supply many needs. So many different gases, all of which can be obtained from liquid air, are used in the Philips' factories that it was very important to have the whole manufacture under one control. Besides argon, which is used for filling electric lamps, the rare gases helium and neon are also used in gas discharge tubes. For glass blowing and in the machine shops large quantities of oxygen are used in order to reach higher combustion temperatures than it is possible to reach with air. Liquid oxygen and nitrogen are both used on a large scale for cooling purposes and as aids in obtaining a high vacuum.

As a protective gas in the working of metal parts for electric lamps and radio valves, much use is made of a mixture of nitrogen and hydrogen. Nitrogen is also used during the manufacture of electric lamps as a washing gas, while it is also used to fill special kinds of lamps. A modern installation for the separation of air by the Linde method is described. Since krypton and xenon have relatively high boiling points, they collect in the liquid container below the main column, which contains oxygen for the most part. Methane occurs in variable amounts in the air and has about the same boiling point as krypton, so that it is collected with the krypton in the liquid oxygen. This leads to difficulties in practice since liquid oxygen together with a combustible substance like methane can easily form an explosive mixture and lead to accidents. Hence the strictest precautions have to be taken in the preparation of krypton and xenon.

Earthquakes registered at De Bilt during 1936

THE "Seismische Registrierungen in De Bilt", **24**; 1936, published in November 1938 and written by Dr. G. Van Dijk with a foreword by Dr. H. G. Cannegieter, contains a description of the instruments in use at the station with the constants necessary for the interpretation of the seismograms obtained, a list of the abbreviations used, acknowledgments, a short

paragraph on microseisms together with a table, followed by fifty-three pages in small clear type of the earthquakes recorded. This record contains details of 443 earthquakes, giving in each case the date, phase and time of recording, the period of the phase, direction of initial impulse and remarks. The remarks consist chiefly of amplitudes, epicentre, and readings obtained by other observers who have communicated with De Bilt. A very sound practice has been not to give the recorded time of every prominent pulse but to limit the identifications to *P*, *PP*, *PPP*, *S*, *SS*, *SSS*, *L*, and *M* phases, so presenting very valuable data for seismological research in many directions.

Diploma in Fuel and Refractory Materials at Leeds

FOR many years past the University of Leeds has provided courses for post-graduate students leading to special diplomas both in gas engineering and in fuel and metallurgy. A one-year course leading to a post-graduate diploma in fuel and refractory materials has now been arranged, in order to meet the growing demand for men with special training in refractory materials. Commencing in October next, the new course will be given in the Department of Coal Gas and Fuel Industries, and will be additional to the normal instruction in the subject received by all students reading for degrees in gas engineering and in fuel and metallurgy. An approved degree in science or technology is required as a preliminary qualification; and the subsequent specialized training in fuel and refractory materials is intended as preparation for entry into either the 'manufacturer' or 'user' sides of the refractories or allied industries. Particulars of these courses may be obtained from the Registrar of the University.

Announcements

THE following awards of the Royal College of Physicians have recently been made: the Moxon Gold Medal to Sir Arthur Hurst, senior physician to Guy's Hospital, for his researches and observations in clinical medicine; the Baly Gold Medal to Prof. C. H. Best, professor of physiology in the University of Toronto, for his physiological researches; the Weber-Parkes Medal and Prize to Sir Pendrill Varrier-Jones, founder and medical director of the Papworth Village Settlement, for his work on tuberculosis at the Settlement.

THE Council of the City and Guilds of London Institute has conferred the distinction of fellow of the Institute upon the following: Mr. L. B. Atkinson, Mr. C. R. Fairey, Mr. E. Fawssett, Dr. L. F. Goodwin, Sir Follett Holt, Sir Gilbert T. Morgan, Mr. F. Handley Page, Sir Leonard Pearce.

A TEAK memorial seat to the late Sir William Perkin, the chemist, is to be unveiled and dedicated to the public at Sudbury, Middlesex, on August 12. The memorial will be outside a recreation ground, and opposite the site where Sir William's house and laboratory stood. The cost of the memorial has been met by public subscription.

DR. GWENVRON M. GRIFFITHS has been appointed to the Kathleen Schlesinger research fellowship for the year 1939–40. The fellowship is provided from a fund established by the late Mr. Eugen M. Schlesinger and Mrs. Schlesinger in memory of their daughter, and is given for investigations of cysts of the brain or allied conditions. It is ordinarily tenable at the National Hospital for Diseases of the Nervous System, Queen Square, London.

PROF. THEODOR VAHLEN, president of the Prussian Academy of Sciences, has been awarded the Goethe Medal for Art and Science by the German Chancellor.

THE Medical Research Council has appointed Dr. Donald Hunter, physician to the London Hospital, and Mr. Harold E. Clay, national secretary of the Passenger Services Group, Transport and General Workers' Union, to be members of the Industrial Health Research Board, in succession to Prof. J. A. Nixon and Mr. R. Coppock.

MR. E. J. LUDLOW of Brylls, Waltham St. Lawrence, Berks, has been awarded the Founders Company fellowship to commence in September next. Mr. Ludlow will be the first person to hold this fellowship, which has been recently created. The normal value of the fellowship is £250 a year and will be renewable for a second year and in special cases for a third year.

MR. PAUL VELLACOTT, headmaster of Harrow, has been elected master of Peterhouse, Cambridge, in succession to the late Prof. H. W. V. Temperley.

THE fourth International Congress for Racial Hygiene will be held in Vienna on August 26–28 under the presidency of Prof. E. Rudin. The fee is 10 marks. Further information can be had from the Office of the Congress, Einemstrasse 11, Berlin, W.62.

IN NATURE of March 25, p. 515, it was stated that the University of Peiping has been reopened under the direction of Prof. Hisomu Nagat, formerly of the University of Formosa. Monlin Chiang, writing as chancellor of the National University of Peking, states that the National University is now in Kunming, Yunnan, as part of the National Southwestern Associated University. He says that, following the fall of the city on July 29, 1937, all the national universities in Peiping moved with their faculties and staffs and almost 90 per cent of their students, leaving behind them practically all their books and apparatus, to the interior and combined into several groups under new names, of which the National Southwestern Associated University is one. As the evacuation took place during the summer vacation, these universities were able to reopen in their new homes more or less according to their original academic calendars, with what little equipment they had secured in the short interval.

ERRATUM.—In NATURE of July 22, p. 150, the dates for the Congress of the International Union against Tuberculosis were incorrectly given as August 11–September 20. They should read September 16–20.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 251.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Expression of Vacuolar Sap

RECENT work carried out here supports some, but, we think, not all of the views recently expressed by Phillis and Mason[1] regarding the composition and structure of cytoplasmic and vacuolar saps in plants. Copper beech leaves which contain anthocyan in the vacuoles of epidermal and palisade tissues were used and were carefully pressed between flat plates in the 50-ton testing machine of the Engineering Department through the kindness of Prof. C. H. Bulleid. Care was taken to avoid slipping of the leaves as suggested by Phillis and Mason.

Juice exudes when the leaves are pressed. Increase in pressure above approximately 400–500 atmospheres does not result in expression of any further appreciable quantities of juice from the leaves when alive and uninjured. If this residue is killed by freezing in solid carbon dioxide a considerable further amount of juice is expressed at these relatively low pressures as described by Phillis and Mason. Data regarding the samples of juice in a typical experiment are given in the accompanying table:

	Before killing			After killing
Pressure applied normal to leaf surface (atmos.) ..	133	280	350	350
Osmotic pressure of expressed juice (atmos.) ..	8	11	11·5	24
Volume of juice per 100 gm. leaf (ml.)	9·5	7·7	2·2	10·1
Colour of juice in Lovibond units per cm. depth—				
Red units ..	22	20	—	10
+ Yellow units ..	22	19	—	6
+ Blue units ..	30	24	—	2
Mean plasmolytic value in atmospheres—epidermis	24			
mesophyll	30–35			

It will be noted that the juice expressed before killing was strongly coloured by anthocyan. In fact, it contained 80 per cent of the total anthocyan. The juice obtained after killing contained little anthocyan and had an osmotic pressure two to three times greater than the juice obtained before killing. It is difficult to escape from the conclusion previously drawn by Phillis and Mason that the first pressing expressed vacuolar sap (of low osmotic pressure) and the second, after killing, expressed cytoplasmic sap. The distribution of anthocyan in the samples rules out the suggestion that the low osmotic pressure of the alleged vacuolar sap is due to filtration of water from the solutes which remain behind.

With a different technique, it is possible to bring about this filtration and compare the two processes. In the experiment just described the pressure was quickly applied, that is, the pressure rose from zero to 133 atmos. in the space of about five minutes. In the 'slow pressure' treatment leaves are subjected to, say, 25 atmos. for about thirty minutes, by which time all the juice expressible at that pressure will have exuded. The pressure is raised at first by 5 atmos., later by about 10 atmos. increments until no further juice is obtained; after each increment the system is allowed to come to equilibrium before the next increment is given. The juice so obtained is colourless and tends towards pure water in composition. In our experiments its osmotic pressure has varied from 1–4 atmos. Finally, when the residue from this treatment is killed by carbon dioxide freezing and pressed, a further quantity of juice is obtained which is strongly coloured by anthocyan and has the very high osmotic pressure of 30–37 atmos. The explanation is that the slow pressure treatment has squeezed out the vacuolar water, leaving the solutes behind, and when the tissue is killed and pressed the juice obtained contains the cytoplasmic water and solutes and the vacuolar solutes also.

With the slow pressure treatment no liquid is obtained at all below about 23–25 atmos. and only traces at this pressure; but in the pressure range 30–50 atmos. about half the expressible liquid is obtained (it should be emphasized that it exudes very slowly, as indeed it exudes very slowly during plasmolysis). When one recalls that the plasmolytic value for the epidermis of these leaves is about 23–25 atmos. this result is very significant and strongly suggests that this figure (the plasmolytic value) actually represents the hydrostatic pressure within the cell.

To conclude, our view is that when a relatively large pressure is suddenly applied, as in the quick-pressure treatment, weak parts of the liquid protoplast are distended and fissures are formed through which the vacuolar liquid is forced. Phillis and Mason suggested expression of vacuoles through fissures without making clear whether they regard these fissures as being produced by sudden application of pressure. When the slow pressure treatment is applied, bursting in this manner does not occur and filtration of water through the semi-permeable protoplast takes place, resulting in a concentrating of the vacuole exactly similar to the concentrating of the vacuole which occurs during plasmolysis. The anthocyan distribution and osmotic pressure data show, we believe, that the vacuolar sap of these leaves has an osmotic pressure of about 8–11 atmos., that the hydrostatic pressure within the cells is about 25–35 atmos. (in the several tissues), and that the difference is attributable to secretory work done by the living protoplasts[2].

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[1] Phillis and Mason, NATURE, **140**, 370 (1937); Brit. Ass. Rep. 1938, p. 493.
[2] Bennet-Clark, Greenwood and Barker, *New Phytol.*, **35**, 277 (1936).

Liberation of Potassium by Acetylcholine in the Central Nervous System

SIMILARITIES in the physiological activities of potassium and acetylcholine have been frequently pointed out[1]. As we know that potassium directly affects the functions of the cells, one should consider whether acetylcholine works through a liberation of ionic potassium or not. This might be the case, as in such organs like muscles and the central nervous system a combined form of potassium has been actually detected. Consequently, the liberation of potassium under the influence of acetylcholine was the first thing to look for.

As an object for our inquiry, we took the central nervous system of the Hungarian Esculenta. The whole nervous system was carefully isolated and cut into two homologous longitudinal portions. Both were soaked in isotonic saline (1 c.c.), one being kept for a control, the other being submitted to the action of the drug. After a while (about one hour), nervous tissue and surrounding saline were treated in a mortar in a final concentration of 96 per cent alcohol, and free, uncombined potassium was estimated in the liquid after centrifuging. The following data have been gathered:

(1) Neither eserine alone nor acetylcholine alone affected the content of free potassium.

(2) Acetylcholine, when eserine had been previously supplied for thirty minutes, increased the ratio of free potassium (12–56 per cent, with an average of 23 per cent).

(3) A previous treatment with atropine inhibits the effect of acetylcholine.

Thus it is demonstrated that acetylcholine liberates potassium from some compound. Considering our experimental conditions are purposely unphysiological in the sense that nervous cells turn rapidly inactive in the absence of oxygen, it is highly probable that the effect of acetylcholine should not be considered as the consequence of a functional alteration due to it, but rather to its primary and direct effect.

What adrenaline would do under the same circumstances is now the matter of our investigations.

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[1] Pichler, *Arch. exper. Pharmakolog.*, **175**, 85 (1934).

Influence of Sodium Chloride on Glucose Absorption from the Intestine of Iodoacetate-poisoned Rats

IODOACETATE poisoning decreases the rate of absorption of glucose and the 'actively absorbed' hexoses from the intestine of rats by about 60 per cent, whereas the absorption of xylose is not affected by this poison[1]. Adrenalectomy has the same effect on sugar absorption[2]. According to Meyerhof[3], iodoacetate acts on glycolysis by suppression of the oxido-reduction between pyruvic acid and triosephosphate. It has been suggested[4] that adrenalectomy influences the glycolytic metabolism in a similar way. Now it has been shown by various American workers that adrenalectomy is followed by a severe disturbance in the excretion and distribution of electrolytes, and that by means of a diet containing no potassium and much sodium it is possible to maintain life with adrenalectomized animals indefinitely. It was therefore tried whether the effect of iodoacetate on sugar absorption also depends on the electrolyte composition.

Female rats of 150–200 gm. were used. Six hours before the absorption experiment they were given subcutaneously 1·5 c.c. 1 per cent NaCl + 0·5 c.c. N/10 Na_2CO_3. Two hours before the absorption this dose was repeated and 1½ hours before the absorption the animals were poisoned with 0·1–0·12 mgm. iodoacetate 1 gm. body weight. The experiments were carried out in urethane narcosis using the same methods as in the above-mentioned previous work[1]. Simultaneously with the sugar, a third dose of sodium chloride (0·5 c.c. 1 per cent subcutaneously) was given. The experiments showed indeed that the inhibiting effect of iodoacetate on sugar absorption is suppressed after sodium chloride administration. The accompanying table shows the experimental data (including experiments in which Na_2CO_3 was replaced by NaCl, and which show the same type of result).

AMOUNT OF GLUCOSE ABSORBED IN 45 MINUTES (PER CENT OF TOTAL AMOUNT INJECTED).

Normal rats	Iodoacetate-poisoned rats		
	Without NaCl	After NaCl + Na_2CO_3 administration	After NaCl administration
83·5	26·0	62·0	73·0
49·3	25·0	75·5	63·2
72·6	28·0	73·0	65·5
62·8	31·0	69·0	81·5
61·5	31·0	58·0	
Average: 65·9	28·2	67·5	70·8

The general toxic effect of iodoacetate on rats is counteracted by sodium chloride in a similar way. Female rats of 90–110 gm. die 12–16 hours after injection of 0·05 mgm. iodoacetate/gm. body weight, whereas after administration of sodium chloride in a similar dose as above they survive after a dose of 0·08 mgm./gm.

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June 19.

[1] Wilbrandt, W., and Laszt, L., *Biochem. Z.*, **259**, 398 (1933).
[2] Wilbrandt, W., and Lengyel, L., *Biochem. Z.*, **267**, 204 (1933). Laszt, L., and Verzár, F., NATURE, **138**, 844 (1936).
[3] Meyerhof, O., *Helv. chim. Acta*, **18**, 1030 (1935).
[4] Laszt, L., and Verzár, F., *Pflügers Arch.*, **236**, 693 (1935).

Nicotinic Acid, Pentose-nucleotides and Anæmia

IN a recent issue of NATURE[1], Caspersson and Schultz stress the importance of the occurrence of pentose-nucleotides in the nucleus and especially in the cytoplasm of cells in rapid mitotic division. Their observations would appear to have a distinct bearing on the subject of the pathogenesis of pernicious anæmia and other blood abnormalities of kindred mode of origin.

Some time ago[2], the suggestion was made that, in these conditions, the normal formation of erythrocytes by the mitotic division and subsequent ripening of the erythroblast was in abeyance: and that the red blood cells were here formed, heteroplastically and directly, from the corresponding hæmocytoblasts (primitive or definitive as the case might be) after multiplication had occurred by an amitotic process.

In support of this hypothesis, it was found[3] in the case of a major sequela of iron deficiency in the pig which was characterized, among other appearances, by great destruction of liver parenchyma and a macrocytic anæmia, that the administration of liver extract produced a dramatic amelioration in which there took place a return of the circulating blood to normality and a replacement of the amitotic hæmocytoblastic blood formation in the marrow by a mitotic erythroblastic one. Recently Elvehjem and his collaborators[4] have shown that liver extract contains nicotinamide, a substance which, as is well known, constitutes with pentose-nucleotide the coenzyme system. Further, Chick and co-workers[5] have demonstrated that nicotinic acid brings about a rapid restoration of health in a condition of the pig termed by them "pellagra", but which, failing evidence to the contrary being forthcoming, would appear to be the iron deficiency sequela.

Caspersson and Schultz emphasize the point that in rapidly growing embryonic tissues (with frequent mitotic division, therefore) the cytoplasm of the cells stains basophile, an occurrence which they attribute to the presence of nucleotides. The characteristic feature of the hæmocytoblast is intense basophilia of the cytoplasm with marked achromasia of the nucleus. This state of affairs, on the contrary, is not associated with mitosis, rapid or otherwise, but with amitotic division, a process recognized by the competent authorities as being, in the majority of cases, a degenerative one. The degenerative aspect of the case is further added to by the fact that ripening of the erythrocyte, whether directly, as here, from the hæmocytoblast or indirectly, as in normal conditions, from the erythroblast, is essentially a degeneration.

In these circumstances it does not appear to be unreasonable to assume that, in mitotic division conditions with rapid increase in the chromatin of the dividing nuclei, nicotinic acid is a necessary adjunct to the nucleotides in the formation of coenzyme for the carrying out of important intracellular functions such as mitosis must be. Its absence would seem to furnish an explanation of the degenerative amitosis, defective chromatin formation, and premature ripening of the erythrocytes in the conditions just considered, in that coenzyme would be unable to function without it: while the return to normality in such cases after its administration could be construed as a restoration of the activity of the coenzyme by its presence.

On these lines it would seem that a tentative understanding of the pathogenesis of the anæmic conditions under discussion could be arrived at, though it is not suggested that nicotinic acid is the sole agent in liver extract which is active in such circumstances. At the same time, it is not supposed that failure of mitotic division in such cases is limited to the cells of the hæmopoietic system.

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[3] Caspersson and Schultz, NATURE, **143**, 602 (1939).
[4] McGowan, "Pernicious Anæmia, etc." (London: Lewis, 1926). *Proc. Roy. Soc. Med.* (Sect. Compar. Med.), **21**, 33 (1928). *Edin. Med. J.*, **37**, 330 (1930); **42**, 293 (1935).
[5] McGowan and Sinclair, *Edin. Med. J.*, **38**, 405 (1931).
[4] Elvehjem *et al.*, *J. Amer. Chem. Soc.*, **59**, 1767 (1937).
[5] Chick *et al.*, *Biochem. J.*, **32**, 10 (1938).

Preliminary Investigation of the Metabolism of Stilbene

EXPERIMENTS on the recovery of synthetic œstrogenic compounds related to stilbene and diphenylethane[1] from the urine of female rabbits have shown that the recoveries are very high compared with that of œstrone under the same conditions[2]. Compounds such as 4 : 4′-dihydroxy-γ : δ-diphenyl-*n*-hexane and 4 : 4′-dihydroxy-α : β-diethylstilbene give recoveries of the order of 20 per cent compared with 1·5 per cent found for œstrone. This indicates a metabolic process for the synthetic œstrogens different from that of œstrone.

In studying the metabolism of these compounds, it was considered of importance to include stilbene, the simplest related active compound, which has been shown to produce full œstrous response in ovariectomized rats when injected in doses of 25 milligrams[3].

Two grams of stilbene were injected into two female rabbits over a period of twenty days, and from the urine a crystalline phenol, melting at 283° C., was isolated. No depression in melting point was observed on mixing with an authentic specimen of 4 : 4′-dihydroxystilbene, melting point 284° C. No *p*-hydroxybenzoic acid was isolated from the urine, but benzoic acid was found in such quantities, more than twice that found in the control rabbit urine, as to leave little doubt that benzoic acid is a metabolic product of stilbene.

It is of particular interest to note that 4 : 4′-dihydroxystilbene is a more active œstrogen than stilbene, as it produces full œstrous response in doses of 10 milligrams, and 60 per cent response in doses of 5 milligrams, when injected into ovariectomized rats[4].

Further extensive work on this subject is now in progress.

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June 24.

[1] Dodds, E. C., Golberg, L., Lawson, W., and Robinson, Sir R., *Proc. Roy. Soc.*, B, **127**, 140 (1939).
[2] Stroud, S. W., *J. Endocrin.*, **1**,
[3] Dodds, E. C., Fitzgerald, M. E. H., and Lawson, W., NATURE, **140**, 772 (1937).
[4] Dodds, E. C., and Lawson, W., NATURE, **139**, 627 (1937).

Vaginal Smears and the Œstrous Cycle of the Cat and the Lioness

A STUDY of vaginal smears taken from ten cats during a period of a year showed that their œstrous cycle consists of the following four chief phases:

(1) *Pro-œstrus*. Characterized by the presence of very numerous nucleated epithelial cells, of fairly uniform shape.

(2) *Œstrus*. The picture obtained is variable, being apparently dependent on the individual intensity of the reaction[1]. Thus in the spring large, flat, non-nucleated cornified cells predominate, together with a smaller number of nucleated cells of similar shape. The proportion of nucleated to non-nucleated cells is reversed during shorter seasons of lower temperature, such as autumn. It should be noted that these are not the only cellular elements of the œstrous smears; smaller, intensely staining round cells, with distinct nuclei, being also encountered

sporadically. The appearance of these uncornified cells may be ascribed to irregular cornification of the vaginal epithelium, as was shown by histological preparations in which differently shaped and non-cornified cells could be observed in the folds of the vagina. The diagnosis of the phase of the œstrous cycle thus depends not only on the presence of characteristic elements but also on their mutual proportions. Thus, the presence of sporadic leucocytes does not exclude œstrus. We would add that the œstrous smears also contain fairly numerous, free deformed nuclei.

(3) *Metœstrus* in the cat is, as in the other animals, characterized by the appearance of masses of leucocytes in the smears. The leucocytes are also evident in histological preparations of the vaginal wall, showing that their appearance is not due to irritation involved in taking smears.

(4) *Anœstrus*. Various types of nucleated epithelial cells, differing in size, shape, and affinity to stains, both of the plasma and the nucleus, are found in anœstrus. The relative proportions of these various cells are neither characteristic nor constant.

Smears were taken from two lionesses in œstrus and anœstrus. During the resting period the smears contained various types of epithelial cells, as in the case of the cat. The œstrous smears contained preponderatingly large, flat, non-nucleated, cornified cells, with a smaller number of cells containing pyknotic nuclei. Here also free deformed nuclei were found. Similar results were obtained for occasionally taken œstrous smears in the wild polecat. Only sporadically were epithelial cells of other types encountered.

It may, on the basis of our findings, be stated that the vaginal smears of the cat and the lioness are practically identical, and may be used for the diagnosis of the phase of the œstrous cycle; the most characteristic is the smear obtained during œstrus.

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[1] Liche, NATURE, 142, 900 (1939).

Δ 3,5-Cholestadiene from Cholesteryl Oleate and its Possible Bearing upon the Formation of Carcinogenic Substances in Heated Fats

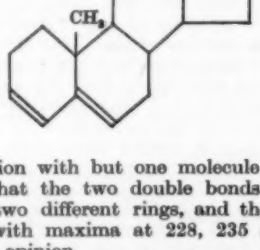
IN recent years, several research workers have studied the problem, whether cancer of the skin in the tropics could be caused by carcinogenic substances formed in the skin after strong irradiation and whether the high percentage of cancer of the stomach in northern regions was connected with the usual diet and its preparation (for example, heating of fats). In a number of communications, Roffo[1] has proved the carcinogenic action by the ultra-violet rays of sunlight, and his results have been corroborated by other authors[2]. He has put forward, too, the theory[3] that a carcinogenic substance may be formed by the action of ultra-violet rays from cholesterine, which accumulates in the skin under the influence of the irradiation. Roffo has tried to strengthen this view by experiments *in vitro* with cholesterine; however, a definite reaction product has not yet been isolated and, moreover, the chemical evidence given is not convincing[4].

Concerning cancer of the stomach, Waterman[5] added heated fats or an extract of them to the diet of mice and observed consequently papillomas of the stomach, in some cases with ulceration. Administration of cholesteryl oleate produced similar results, even of greater malignity[6].

According to Roffo[7], oral administration of irradiated cholesterine, irradiated egg-yolk, or several fats boiled for thirty minutes causes neoplastic alterations of the alimentary tract of mice.

Recently, Domagk[8] in some cases obtained tumours of the stomach in mice fed on a diet rich in olive oil, while Widmark[9] concludes from his experiments that extracts of roasted food (horse muscle treated at 275° C., browned butter and roasted coffee) contain one or more carcinogenic substances. In collaboration with Dr. Waterman, we have attacked the problem from the chemical side by trying first to isolate an active substance from heated fats, secondly studying the pyrolytic decomposition of cholesteryl oleate as a type of cholesteryl ethers, which occur normally in fats. In the latter case, one may expect[10] the formation of an unsaturated steroid hydrocarbon, related to those studied by Staveley and Bergmann[11] "in order to discover whether the presence of any particular number and arrangement of double bonds would produce carcinogenicity in steroids" and to Δ 2,4-cholestadiene, the photo-oxide of which has been studied by Butenandt and Kudfuss[12] upon carcinogenic activity in tarring experiments.

Therefore synthetic cholesteryl oleate (British Drug Houses) was distilled *in vacuo* (0·3 mm., bath temperature 300–340° C.). From the distillate a hydrocarbon $C_{27}H_{44}$ was isolated with m.p. 77–78° C. and $\alpha_D^{20} = -114°$. (Analysis $C_{27}H_{44}$: C. 87·96, H. 12·04. Found C. 87·68, H. 11·89.) From this evidence we conclude that we are dealing with Δ 3,5-cholestadiene[11].



The reaction with but one molecule of bromine, indicating that the two double bonds present are located in two different rings, and the absorption spectrum* with maxima at 228, 235 and 243 mμ confirm this opinion.

In feeding experiments with this hydrocarbon in a group of mice during a year, Dr. Waterman[13] obtained four papillomas of the stomach, one of which showed infiltrating properties. Though these experiments are to be continued for a longer time and on a larger scale, it seems to be very probable that a carcinogenic hydrocarbon may be formed from a cholesterine ether occurring in fats. With regard to this property, other cholesterine ethers are being examined.

The isolation of Δ 3,5-cholestadiene[14] from *irradiated* cholesteryl acetate, which substance otherwise

* I am greatly indebted to Prof. L. S. Ornstein and co-workers, Utrecht, for measuring this and other absorption spectra.

can be distilled without decomposition, possibly forms a linkage between the thermal decomposition of a cholesterine derivative examined and the changes brought about by irradiation in Roffo's experiments. If so, the irradiation experiments carried out *in vitro* with free cholesterine should be extended to cholesterine ethers.

Still in another way these facts are linked together, considered in connexion with the results of a recent investigation by Waterman[15], who, studying carcinogenic hydrocarbons polarographically, found that many of them, and also △ 3,5-cholestadiene and irradiated cholesteryl oleate, showed a reduction interval at 350 mv, while cholesterine, irradiated or not, did not possess this property.

From later experiments[12] it appeared that the unsaponifiable matter of heated fat, freed to a large extent from sterols, showed the same reduction phenomenon and that the similar fraction from unheated fat did not do so.

Synthetic cholesteryl oleate in higher concentrations than formerly used also gives the same interval (according to the mode of preparation the presence of traces of △ 3,5-cholestadiene may be expected !).

The details of this investigation, together with the results of feeding experiments by Dr. Waterman, will be published elsewhere.

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June 21.

[1] Roffo, A. H., *Bol. Inst. Med. Exp. Estud. Cancer* (1933–1938), compare *Z. Krebsf.*, **47**, 473 (1938).
[2] See literature cited by Bergman, W., *Z. Krebsf.*, **48**, 546 (1939).
[3] Roffo, A. H., *Z. Krebsf.*, **47**, 473 (1938).
[4] Compare the detailed critical survey by Bergmann, *loc. cit.* 2.
[5] Waterman, N., Conférence Leeuwenhoek-Vereeniging V. 86, Paris, 1937 (in details still to be published).
[6] Waterman, N., *Acta Cancrologica* ii, 5/6, 375 (1936); *Naderl. Tijdschr. Geneesk.*, **81**, 1273 (1937); *Acta brevia neerlandica*, **7**, 18 (1937) and *loc. cit.* 5.
[7] Roffo, A. H., *loc. cit.* 3.
[8] Domagk, G., *Z. Krebsf.*, **48**, 284 (1939).
[9] Widmark, E. M. P., NATURE, **143**, 984 (1939).
[10] Compare Dimroth, K., Trautman, G., *Ber.* **69**, 669 (1936). (Formation of a cholestadiene from 7- hydroxy-cholesterine-benzoate).
[11] Staveley, H. E., Bergmann, W., *J. Org. Chem.*, **1**, 567, 575 (1936). See also, Eck, J. C., van Peursem, R. L., Hollingsworth, E. W., *J. Amer. Chem. Soc.*, **61**, 171 (1939).
[12] Butenandt, A., Kudfuss, H., *Z. Physiol. Chem.*, **253**, 1 (1938).
[13] To be published in *Acta Internat. Contra Cancrum.*
[14] Bergman, E., Hirsberg, Y., NATURE, **142**, 1037 (1938).
[15] Waterman, N., *Acta brevia neerlandica*, **9**, 143 (1939).

Constitution of Solasonine (Solanine-*s*)

FURTHER analyses of the gluco-alkaloid, solasonine (solanine-*s*), the aglycone, solasodine (solanidine-*s*) and its derivatives are in agreement more with the molecular formulæ, $C_{45}H_{73}O_{16}N$, for the glycone and $C_{27}H_{43}O_2N$ for the aglycone. Formulæ, $C_{27}H_{41}O_2N$ and $C_{28}H_{43}O_2N$, for the aglycone and corresponding formulæ for the gluco-alkaloid are not yet excluded but are less likely on theoretical grounds. From biochemical considerations a formula containing 27 carbon atoms is also to be preferred since there are no well-authenticated steroid derivatives, with the exception of solanocapsine and solanocapsidine[1] to which the same argument may apply, containing 26 carbon atoms. Since solasonine gives rise to glucose, galactose, rhamnose and solasodine on hydrolysis[2], it must now be built up from these sugars and one molecule of the aglycone and not two as suggested by Oddo.

According to Oddo and his co-workers, solasodine contains two active hydrogens (Zerewitinoff) and forms an amorphous diacetyl derivative (a crystalline monoacetyl derivative has now been obtained, m.p. 195°, which is soluble in dilute acids). Since it gives with nitrous acid a crystalline compound richer in nitrogen, Oddo concluded, on the basis of a formula, $C_{18}H_{31}ON$, that solasodine contains both a hydroxyl and a secondary amino group.

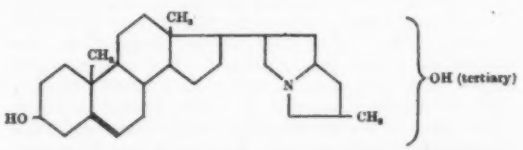
When the compound formed by nitrous acid is crystallized from alcohol containing a little ammonia, however, pure solasodine is regenerated indicating its salt-like character. Also, solasodine yields quaternary salts by simple addition [methiodide, m.p. 286° (decomp.), ethiodide, m.p. 284° (decomp.)] so that it is a tertiary base. A Zeisel estimation shows the absence of an NCH_3 group so that the nitrogen probably forms part of two rings.

Consequently, both oxygens must be present as hydroxyl groups (Zerewitinoff) and since only a monoacetyl derivative is formed, the second hydroxyl group is probably tertiary. Dehydration by means of methyl alcoholic hydrogen chloride removes one hydroxyl forming dehydrosolasodine, identical with 'solanidine-*s* ether'[3] and 'solanosodine'[3] and the same compound has also been isolated from the mother liquors during the purification of solasodine (cf. Rochelmeyer[3]).

On selenium dehydrogenation, methylcyclopentenophenanthrene and pyrrole bases are produced[4] indicating a steroid structure. It gives a digitonide[5] thus placing one hydroxyl group in *cis* position on C_3.

Solasodine forms a hydroderivative on catalytic hydrogenation and a dibromo derivative by addition. It must therefore contain one double bond, provisionally placed on analogy with other steroids at C_5—C_6.

On the above evidence and assuming a cholesterol carbon skeleton and one point of attachment of the basic portion to the steroid nucleus, the structure of solasodine is most probably



The same conclusion has been reached by Clemo, Morgan and Raper[6] for the basic structure of solanidine which is very similar in its chemical reactions to solasodine. It would appear therefore that solasodine is a hydroxy derivative of solanidine. On this basis, complete hydrogenation of dehydrosolasodine should possibly yield dihydrosolanidine and this relationship is being further investigated. Solangustidine[6], which is now isomeric with solasodine, may also be similarly closely related.

Both solasodine and solanidine give a series of beautiful colour reactions with *p*-substituted aldehydes and acetic-sulphuric acid, indicative of a pyrrolidine rather than a piperidine type of compound.

With R. Culford Bell, the alkaloid purapurine[7] from the fruit of *Solanum aviculare* has now been shown to be identical with solasonine, while a more detailed examination of the alkaloid from *S.*

auriculatum[6] has shown that it is not identical with solasonine.

Thanks are due to the Chemical Society and the Australian and New Zealand Association for the Advancement of Science for grants.

L. H. BRIGGS.

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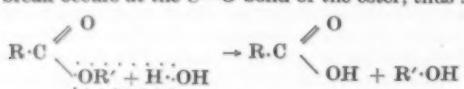
June 1.

[1] Barger and Fraenkel-Conrat, *J. Chem. Soc.*, 1537 (1936).
[2] Oddo and Caronna, *Ber.*, **67**, 446 (1934) and earlier papers.
[3] Rochelmeyer, *Arch. Pharm.*, **275**, 336 (1937).
[4] Rochelmeyer, *Arch. Pharm.*, **274**, 543 (1936).
[5] Clemo, Morgan and Raper, *J. Chem. Soc.*, 1299 (1936).
[6] Tutin and Clewer, *J. Chem. Soc.*, **105**, 565 (1914).
[7] Levi, *J. Soc. Chem. Ind.*, **49**, 395 T (1930).
[8] Anderson and Briggs, *J. Chem. Soc.*, 1036 (1937).

Mechanism of Hydrolysis of Inorganic Esters

BY the use of water containing an excess over the normal of the heavy oxygen isotope (^{18}O), it has been definitely and very directly shown that during the hydrolysis of the esters of weak carboxylic acids the break occurs at the C—O bond of the ester, thus :



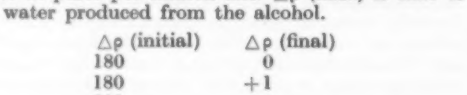
Thus the alcohol resulting from the hydrolysis contains only the normal proportion of heavy oxygen isotope. This has been shown by Polanyi and Szabo[1] for the case of alkaline hydrolysis and by Datta, Day and Ingold[2] for the case of acid hydrolysis after Roberts and Urey[3] had shown that the same C—O bond is involved in the reverse process of esterification.

We have recently carried out a similar experiment on the alkaline hydrolysis of trimethyl phosphate, using aqueous sodium hydroxide prepared by acting with sodium on water enriched in the heavy oxygen isotope. The hydrolysis was carried out at 80–90° C. and proceeded until slightly more than one methyl group was removed. The resulting aqueous methyl alcohol was distilled off and purified by fractionation. The alcohol vapour was then passed over a red-hot platinum filament, whereby it was 'cracked' to give carbon monoxide and hydrogen. The mixture, plus excess hydrogen, was passed over a nickel catalyst and the carbon monoxide thereby reduced to water. This water thus contained the oxygen for the alcohol produced in the hydrolysis. Its density was measured, after purification, by the usual micro-pyknometer method[4].

The results are shown in the accompanying table, where $\Delta\rho$ (initial) is the excess density of the original water in parts per million and $\Delta\rho$ (final) is that of the water produced from the alcohol.

$\Delta\rho$ (initial)	$\Delta\rho$ (final)
180	0
180	+1
200	0

The results show quite clearly that during the hydrolysis the P—O bond of the ester is broken thus :



The experimental error of the density measurement may be taken as ± 5 parts per million, so that at least 97 per cent of the hydrolysis must proceed as indicated above.

This is a somewhat surprising result in view of the fact that trimethyl phosphate is a fairly efficient methylating agent[5].

Density measurements of the residual water show that, apart from the hydrolytic *replacement* of oxygen, there is only a very slight *exchange* of oxygen between the water and the ester.

During the hydrolysis carried out as described above, a considerable quantity of dimethyl ether is produced. We are endeavouring to determine whether or not this ether contains excess of ^{18}O, and also to investigate the course of the hydrolysis in acid solution. We also hope to extend the work to other inorganic esters.

J. B. M. HERBERT.
E. BLUMENTHAL.

The University,
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June 30.

[1] Polanyi and Szabo, *Trans. Far. Soc.*, **30**, 508 (1934).
[2] Datta, Day and Ingold, *J. Chem. Soc.*, 838 (1939).
[3] Urey and Roberts, *J. Amer. Chem. Soc.*, **60**, 2393 (1938).
[4] Gilfillan and Polanyi, *Z. phys. Chem.*, **166**, 254 (1933).
[5] Noller and Dutton, *J. Amer. Chem. Soc.*, **55**, 424 (1933).

Application of the Coincidence Method to Testing the Lifetime and Level Scheme of Radium C′

THE application of the coincidence method to investigations of nuclear processes may be extended in certain ways by using a variable resolving time of the coincidence circuit and by measuring pseudo-coincidences, that is, counts arising from two impulses which are not simultaneous but separated by a very short time. The number of 'coincidences' given by two particles, in which one follows the second in a time determined by the radioactive constant λ, is proportional to $1 - e^{-\lambda\tau}$, τ being the length of the impulse. The duration of the impulse is dependent upon the electrical constants of the circuit, and by changing the constants of one or both circuits it is possible to obtain various determined lengths of the impulses. In order to measure λ, two sets of experiments are made : (*a*) with the impulse τ_1 of the first particle long and of different durations, and the impulse τ_2 of the second very short ; (*b*) with the conditions reversed. The difference $a-b$ is equal to $\frac{N_1N_2}{N}(e^{-\lambda\tau_2} - e^{-\lambda\tau_1})$ where N_1 and N_2 are the number of counts in each counter, N the number of disintegrations. The method of lengthening the impulses only from one kind of particle allows one also to decide the order in which the particles are emitted.

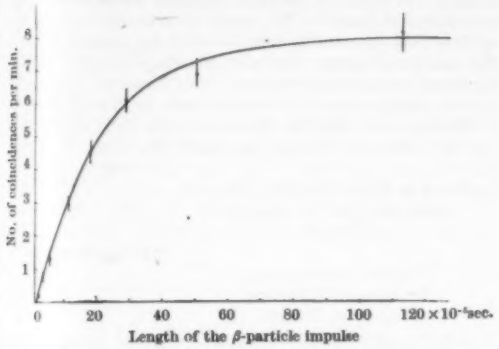
In these experiments the method was applied to the transformation

$$\text{RaC} \xrightarrow{\beta} \text{RaC}' \xrightarrow{\alpha} \text{RaD}.$$

Coincidences were observed between the various types of radiations, namely, $\alpha-\beta$, $\alpha-\gamma$, $\beta-\gamma$, and $\gamma-\gamma$. The β- and γ-radiations were measured in the usual way by means of Geiger-Müller tubes ; the α-particles were counted separately by operating a Geiger-Müller tube in the proportional region. The curve on the accompanying graph gives the number of real 'coincidences' ($a-b$) from radium C β-particles and radium C′ α-particles as a function of the length of the impulse from the β-particles. From this curve one obtains a value for the half-lifetime of radium C′ of $1{\cdot}40 \pm 0{\cdot}15 \times 10^{-4}$ sec.*

The investigation of the $\alpha-\gamma$ coincidences gives a curve which is identical with the former, showing

that no γ-radiation follows the emission of the α-particle, and thus giving a direct proof that there do not exist any γ-rays of appreciable amount arising from the transition RaC′ → RaD. The measurements of the β−γ and γ−γ 'coincidences' show no dependence on the length of the impulses, showing that none of the excited levels can have a lifetime longer than 10^{-8} sec.



Length of the β-particle impulse

In order to check the level scheme of radium C′ of Ellis and Oppenheimer[1], sets of measurements were made of the coincidences between β−γ and γ−γ due to the radiations from radium C and C′. The β−γ coincidences were measured as a function of the absorption of the β-particles. The result is that the ratio of coincidences to the number of β-particles decreases rapidly with the thickness of the absorber, but becomes nearly constant for thicknesses of 1·3–2 mm. aluminium. The presence of coincidences at an absorber thickness of 2 mm. aluminium shows that even the hardest β-group (upper limit 3·15 Mv.) is connected with the γ-rays, in agreement with the scheme of Ellis and Oppenheimer. This latter result is in contradiction to the results of Bothe and Maier-Leibnitz[2], who found no coincidences between the hard β-rays and the γ-rays, an observation very difficult to reconcile with the level scheme.

Although my own results agree broadly with the level scheme, a closer comparison shows certain discrepancies; the decrease in coincidences with absorber thickness is more rapid than expected, and the number of coincidences with the hard β-rays is too small. It ought to be mentioned that the comparison is very dependent on the values adopted for the efficiencies of the γ-counter for rays of different energy. Special experiments were made in order to determine these values. The differences between the expected and experimental results are greater than the possible error in the determination of the efficiencies and must be explained in some other way.

The γ−γ coincidences were also measured as a function of the thickness of lead between the source and one γ-counter. The shape of the experimental absorption curve of the relative number of coincidences is in fair agreement with the values expected from the level scheme.

J. ROTBLAT.

George Holt Physics Laboratory,
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July 19.

* *Footnote added in proof.* J. V. Dunworth has recently (NATURE, July 22, p. 152) used the same principle. His result for the half value period of radium C′ is 1·50 × 10^{-4} sec., in good agreement with that given here.

[1] Ellis, C. D., International Conf. of Physics, London, 1934.
[2] Bothe, W., and Maier-Leibnitz, H., *Z. Phys.*, **104**, 604 (1937).

Adsorption of Helium Gas on Active Charcoal between 4·2° and 1·78° K.

MEASUREMENTS have been made on the adsorption of helium gas on charcoal between 4·2° and 1·78° K. We determined the quantity adsorbed at various pressures and various temperatures. At the same time we also observed the adsorption velocity.

Above the λ-point, the adsorption seems to be normal. However, on passing the λ-point, the adsorption seems suddenly to be stopped (this could not be explained by the 'film' phenomena). Further, it seems to us that the adsorbed helium assumes a metastable state. The equilibrium pressure remained practically constant on lowering the temperature still further. However, at 1·97° K., the adsorption started suddenly again. It was also possible to get the adsorbed helium from this metastable state by a slight increase of temperature.

By increasing the temperature, starting from a temperature below the λ-point, it was again found that the adsorption becomes constant on passing the λ-point.

Briefly, it seems to us that the observed phenomena shows a certain analogy with 'critical' adsorption.

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J. BORGHS.

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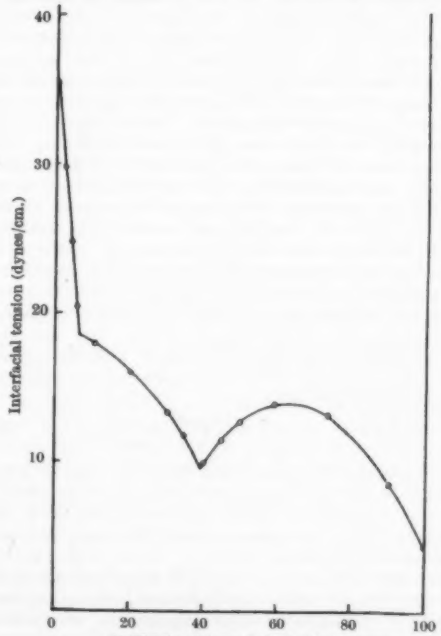
'Breaks' in Interfacial Tension Curves

WHEN a single solute is adsorbed from one phase to a water – oil interface, the interfacial tension usually falls in a regular manner with increasing adsorbate concentration, to a limiting value corre-



INFLUENCE OF BENZYL ALCOHOL ON BENZENE–WATER INTERFACIAL TENSION

sponding to a close-packed monomolecular surface layer. In the very few cases[1] where exceptions have been found to this rule, the adsorbates have been soaps or similar hydrolysable molecules, and inter-attraction between the long-chain molecules and their products by hydrolysis has been given as explanation of the sharp breaks which occur in the interfacial tension – adsorbate concentration curves.

In order to test this, a study has been made of much simpler systems where no secondary reaction is possible. The accompanying graph represents the change in interfacial tension between water and benzene as molecules of benzyl alcohol accumulate at the interface, and was obtained by measuring[2] the tension between a water phase saturated with benzyl alcohol, and a benzene phase containing varying amounts of the alcohol. The curve shows two very well-defined breaks, indicating that such breaks must be due to a much simpler cause than has hitherto been believed; it is suggested that they occur whenever an amphipathic adsorbate is soluble in both phases, and that the *two* breaks which normally occur represent the beginning and the end of interpenetration of two identical adsorbed films. It is significant that no break is obtained in the curve for benzyl chloride, which is soluble only in the benzene phase.

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Preston.

[1] Powney and Addison, *Trans. Faraday Soc.*, **34**, 628 (1938).
[2] Powney and Addison, *Trans. Faraday Soc.*, **33**, 1243 (1937).

On the Theory of Dielectric Polarization in Liquids

ONSAGER[1] has developed a theory of the dielectric polarization in liquids, in many respects different from the current theory of Lorentz-Debye. We propose to show that the method of calculating the dipole energy, used by Onsager in his theory, does not correspond exactly to the assumptions of this theory. Onsager calculates the momentum of forces rotating the molecule in such a manner as if the rotation of the resulting moment (being the vectorial sum of both the permanent and induced moment) were decisive for the rotation of the molecule. In fact, however, only the axis of the permanent moment, and not that of the induced moment is rigidly bound to the isotropic molecule. This fact causes the real expression for the energy of the molecule to differ from the formula presented by Onsager. We obtain therefore instead of Onsager's formula:

$$\frac{4\pi N\mu^2}{9kT} = \frac{(\varepsilon-n^2)(2\varepsilon+n^2)}{\varepsilon(n^2+2)^2} = \rho(\varepsilon, n), \quad . \quad . \quad (1)$$

the following expression:

$$\frac{4\pi N\mu^2}{9kT} = \rho(\varepsilon, n) \cdot \frac{2\varepsilon+n^2}{2\varepsilon+1} \cdot \frac{3}{n^2+2}, \quad . \quad . \quad . \quad (2)$$

where μ denotes the permanent moment of an isolated molecule (that is, measured in the vapour state), ε is the dielectric constant of the liquid, n is its refractive index (for $\lambda = \infty$) and N is the number of molecules per ccm.

Böttcher[2] has proved on ample experimental data that formula (1), when applied to numerous liquids, gives for μ values in excellent agreement with those determined from measurements of the dielectric constant of vapours. If we apply, on the other hand, to the same liquids the corrected formula (2), we obtain lower values, generally by about 15 per cent. The deviations therefore between Onsager's theory and experiment become rather considerable. For example, for nitrobenzene, in which $\mu = 4{\cdot}2$ (determined in the vapour), formula (1) gives $\mu = 4{\cdot}2$, while formula (2) gives $\mu = 3{\cdot}6$.

Onsager deduces also an expression for the ratio $\mu_{app.}/\mu$, where $\mu_{app.}$ denotes the dipole moment determined by Debye's method applied to solutions in non-polar solvents. We have shown that the value of this last expression turns out to be greater than 1 for such solutions as nitrobenzene-hexane, nitrobenzene-benzene and others. It is, however, generally known that numerous experiments yield $\mu_{app.}/\mu < 1$.

The question will be discussed more fully in a paper to be published shortly in *Bull. Ac. Pol.*

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Rydzyna, Poland.

[1] Onsager, L., *J. Amer. Chem. Soc.*, **58**, 1486 (1936). See also Falkenhagen, H., *Phys. Z.*, **39**, 806 (1938).
[2] Böttcher, C. J. F., *Physica*, **6**, 59 (1939).

Avoidance of Crystal Formation during Embedding of Plant Material in Paraffin Wax

THE formation of wax crystals in paraffin blocks containing material for microtoming is a common source of annoyance. As a result of various trials, I have found that the following simple method eliminates the trouble, at least in so far as the various types of wax used in this department are concerned.

Float 'boat' containing melted wax and material suitably spaced in a 500 c.c. beaker containing water the temperature of which is within a few degrees of zero and in which ice is floating. As soon as possible submerge block and remove it from 'boat'. Keep block submerged until hard, and repeat process until all material has been embedded. Then transfer the beaker containing the paraffin blocks to a refrigerator at a temperature about 5° or 6° C. and leave there for one or two days. Then remove beaker from refrigerator, and allow the water and wax therein gradually to assume the temperature of the atmosphere. The paraffin block is now ready for immediate or future use.

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June 14.

Insects in Aircraft

DR. WHITFIELD'S recent communication on this problem[1] rightly emphasizes its importance. But it might be gathered from his letter that it is a new problem—one which has hitherto received little attention or one for which no adequate preventive measures have been devised.

Such assumptions would be wrong. The problem has exercised the minds of tropical sanitarians at least since the time of Manson, and the danger is one which has been reiterated on many occasions by the Ross Institute and other authorities. Active measures have been taken and are being taken by aircraft companies and by the sanitary authorities

in various African airports, notably Cairo, Khartoum and Durban, to minimize or abolish noxious insects from aircraft.

The work of Dr. Park Ross of Durban, Mr. C. B. Symes of Kenya Colony, the Entomological Staff of the Government of India and by ourselves, as well as the valuable work of Mr. Whitfield himself at Khartoum, has served to throw considerable light on this problem and the measures taken to meet it. We[1] have found that there are at least two efficient aqueous base pyrethrum insecticides on the market which, applied in the dilutions we suggest, will ensure the death of mosquitoes and other flying insects in aircraft within a few minutes of application.

Preparations of pyrethrum are being used all over the world by aircraft companies and ground sanitary authorities, and we may safely say that science has provided the means of abolishing the danger of insect transmission by aircraft, and it only remains for international authorities to insist on these measures being carried out.

The authority responsible for these regulations is the International Sanitary Convention for Aerial Navigation, but this body has unfortunately laid down no precise rules on the subject. The responsibility for doing this and the manner of doing it is at present left to the decision of each authority concerned, with the result that the methods used in different countries vary considerably in their efficiency.

It is hoped that Mr. Whitfield's letter will impress all concerned with the necessity of concerted action to meet this danger, in place of the inco-ordination of effort which at present exists.

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July 25.

[1] NATURE, **144**, 158 (1939).
[2] Mackie and Crabtree, *Lancet*, 447 (August 20, 1938).

Points from Foregoing Letters

RAPID application of pressure to beech leaves which have coloured vacuoles expresses sap of low osmotic pressure (about one third of the plasmolytic value) containing 80 per cent of the vacuolar pigment. T. A. Bennet-Clark and Dorothy Bexon support the contention of Phillis and Mason that this treatment expresses vacuolar sap rather than water which is filtered from the solutes.

W. Dulière and O. Loewi have found that acetylcholine, when applied after eserine, liberates ionic potassium in the isolated nervous system of the frog.

L. Laszt finds the inhibiting effect of iodoacetate on glucose absorption from the intestine of rats is suppressed by sodium chloride in a similar way as sodium salts counteract the symptoms of adrenalectomy.

J. P. McGowan shows that an important phase in the histogenesis of red blood cells in pernicious and some other anæmias would appear to be the multiplication of the hæmocytoblasts by amitotic division and the subsequent ripening of these into erythrocytes. When nicotinic acid is administered, it is suggested that this forms with the pentose-nucleotides present in the cytoplasm of the hæmocytoblasts—the coenzyme system. The latter then plays an important part in the development and mitotic division of the erythroblasts which are now the cells which ripen to erythrocytes.

4 : 4′-dihydroxystilbene and benzoic acid have been isolated by S. W. Stroud as metabolic products from the urine of rabbits injected with stilbene.

H. Liche and K. Wodzicki describe the vaginal smears obtained during various phases of the œstrous cycle of cats. The similarity between smears for cats and lionesses is pointed out. In both species, the smears may serve for diagnosis of the phase of the œstrous cycle.

By thermal decomposition of cholesteryl oleate, Δ 3,5-cholestadiene was obtained by H. Veldstra. In feeding experiments by Waterman with mice this substance caused papillomas of the stomach, one of which showed infiltrating properties. As cholesteryl ethers normally occur in fats, the formation of carcinogenic substances by heating of fats has to be considered as possible.

Further analyses of solasonine and solasodine are in agreement with molecular formulæ, $C_{45}H_{73}O_{14}N$ and $C_{27}H_{43}O_2N$, for these bases, and from chemical evidence a constitutional formula for solasodine is proposed by L. H. Briggs. A comparison of its chemical properties with those of solanidine indicates that solasodine is possibly a hydroxy derivative of solanidine.

By using water containing excess of heavy oxygen isotope J. B. M. Herbert and E. Blumenthal show that the mechanism of hydrolysis of trimethyl phosphate in alkaline solution is the same as that for the hydrolysis of the simple organic esters. That is, that the rupture occurs at the P–O bond of the ester.

By the use of a coincidence apparatus with a variable resolving time, J. Rotblat has found the half value period of radium C′ to be $1{\cdot}40 \times 10^{-4}$ sec. He has also shown that no γ-radiation is emitted in the transition radium C′ → radium D. Coincidence observations on the radiations emitted in the process radium C → radium C′ → radium D have also been made, from which deductions concerning the level scheme of radium C′ are drawn. The results confirm in general the accepted level scheme, but certain discrepancies remain to be examined.

C. C. Addison finds that the breaks in interfacial tension curves, usually associated with complex systems, are found to occur in the simple benzene–benzyl alcohol–water system; he believes them to be due to penetration of two identical adsorbed layers.

K. Zakrzewski and A. Piekara criticize Onsager's theory of dielectric polarization in liquids, and give a modified expression for Onsager's formula which corresponds more strictly to the assumptions of the theory. This theory, however, yields values deviating considerably from the experimental data.

P. Brough describes a simple method whereby crystal formation, commonly experienced during embedding of plant material in paraffin wax, may be avoided. The essentials of the process are rapid cooling of wax during embedding, the immediate transfer of the blocks to a refrigerator and the gradual bringing of the temperature of the wax to that of the laboratory.

RESEARCH ITEMS

Maya Mounds of British Honduras

THE late T. W. Gann, with Mary Gann, in the course of two seasons spent in the Corozal District of British Honduras, between the valleys of the Rio Hondo and the Rio Nuevo examined by excavation a number of mounds belonging to the ancient Maya civilization. These centred around a group of large banks and mounds known to the Indians as Nohmul, or Great Mound, so called because one of the pyramidal structures is the loftiest in the district, reaching a height of 95 ft. In a report on the excavations (Smithsonian Institution: *Anthropological Papers Bull.*, 123; 1939), Dr. Gann points out the probable influence of a liberal water supply in determining the choice of this site for settlement. In all, 28 mounds were examined, these falling into six distinct groups. (1) Burial mounds unassociated with either cists or stucco floors, numbering ten in all, probably the graves of poor people, grave furniture being scanty and poor. (2) Sepulchral mounds with the corpse buried above or below the former floor of a house. Of these there were four; and they probably belonged to householders of sufficient importance to have their houses wrecked and converted into burial mounds. (3) Sepulchral mounds containing specially constructed burial cists. These, including the great mound of Nohmul itself, number eight. They vary in height from 9 to 95 ft., and contain all the finest artefacts of shell, stone, pottery, etc. In some the cists were beneath the floors of houses, in others the mounds were constructed specially to cover them. (4) Mounds constructed over the ruins of stone buildings and not used for sepulchral purposes—five in number, all flat-topped, and of very solid masonry. (5) Mounds built over the former floors of wood or adobe buildings, not containing burials. Of these there were two, each appearing to have been low stucco-covered substructures of houses of perishable materials. (6) Mounds containing only fragments of crude clay censers. Two were examined.

Ontogeny and Phylogeny of the Human Nose

THAT very prominent feature of the human face, the outer nose, its various types and their methods of growth, have been investigated by C. B. Benedict (*Proc. Amer. Philos. Soc.*, Jan. 1939). The anatomical elements concerned in the formation of the outer nose are considered and their histories in the fœtus outlined. Five absolute measurements and eight ratios are employed for the purpose of statistical definition. A large series of measurements on persons from three to twenty years of age and of different races were taken. Nasal height increases *pari passu* with stature; but becomes greater in boys than in girls. This sexual difference, which is widespread, is due in large measure to the greater body size in boys, on the average; but also to the earlier differentiation of the nose in the female which is related to the earlier assumption of maturity. The wide diversity of the shape of the nose in various races suggests that a number of different genes are involved in its development. Comparison with lower forms suggests that the ontogenetic succession follows the phylogenetic steps.

Determination of Histamine in Biological Extracts

M. ROCHA E SILVA, of the Instituto Biologico, S. Paulo, Brazil, has introduced a slight alteration in Code's method for estimating histamine, which permits a big reduction in the final volume of the extract (*Arqu. Inst. Biol.*, 9, 145; 1938). Code's method is a modification of that of Barsoum and Gaddum. In this last technique, after removing the proteins by trichloracetic acid, and the acid by ether, the filtrate is boiled with hydrochloric acid for 90 minutes and then dried *in vacuo*. The dry residue is extracted with hot alcohol saturated with sodium chloride. Code has shown that the most serious loss of histamine occurred in the extraction of the dried residue by alcohol. Aqueous extraction in Code's method gave higher and more consistent recoveries, but the removal of an excess of salts that was possible by Barsoum and Gaddum's method is not possible by Code's method. It is true that it was shown by Code that the salt content of extracts of the blood constituents does not interfere with the reaction of the guinea pig ileum to histamine; but in certain circumstances it may be very important to effect a big reduction in the final volume in order to attain more accurate results. The following technique has been devised: (1, 2) The filtrate, after precipitation with trichloracetic acid, is boiled with one tenth of its volume of concentrated hydrochloric acid. (3) This boiling is carried out until crystallization of the salts begins. The water is also carefully evaporated, avoiding any deposition of solid cakes on the wall (complete dryness must also be avoided). (4) A few c.c. of 96 per cent alcohol saturated with sodium chloride is added. Filtration allows a complete removal of the precipitated salts. The filter is washed out repeatedly with the same 96 per cent alcohol saturated with sodium chloride. (5) The filtrate is dried *in vacuo*, the hydrochloric acid removed by repeated additions of absolute ethyl alcohol, and (6) the residue dissolved in a small volume of saline. The removal of the excess of salts permits a big reduction in the final volume of the extracts, without interference with the guinea pig gut reaction for histamine. This method is being used for determining the histamine content in fluids (blood plasma) where the usual content is very low.

Sex Determination in Melandrium

H. E. Warmke and A. F. Blakeslee (*Science*, 84. 391–392; 1939) have studied the sex determination in polyploid forms of Melandrium produced by colchicine treatment. Plants of the chromosome constitution $3A + XXY$ and $4A + XXXY$ are fertile males whereas $4A + 3X$ is a female. This indicates that the Y-chromosome is active in sex determination, contrary to the situation in Drosophila. A hermaphrodite results from the constitution $4A + 4X + Y$. 37·5 per cent of the meiotic associations in an $XXYY$ complex consist of $X - X$ and $Y - Y$ bivalents, and the remainder are chiefly associations of 4 chromosomes. It is pointed out that a polyploid sex mechanism of $XXXX$, $XXXY$ is comparable in efficiency and survival value with that in the diploid.

Fifteen Years' Research on Datura

A. F. Blakeslee and A. G. Avery ("Co-operation in Research", Carnegie Institute, 501, 315–351; 1938) have summarized the data on 60,000 trisomic plants in *Datura stramonium*. The viability of the primary and secondary trisomics differs widely, ranging from 32·7 per cent for $2n + 23{\cdot}24$ to 3 per cent for $2n + 19{\cdot}20$. The proportions of primaries thrown by the related secondary trisomics also varies, and this indicates that disjunction is not at random. More unrelated primaries are given by primaries than by normal types, indicating that general non-disjunction is more common in $2n + 1$ types than in diploids. Double trisomics $2n + 1 + 1$, however, show a decreased production of unrelated primaries. Rates of non-disjunction are different in different chromosomes, and these are not correlated with the size of chromosome.

Chlorophyll Deficiencies in Red Clover

R. D. WILLIAMS (*J. Genet.*, **37**, 440–458 and 459–481) has identified genetically eight genes for albino seedlings and seven for yellow, chlorophyll-deficient lethal seedlings in red clover. In addition, ten other albino and nine other yellow chlorophyll-deficient types were found. Linkage between some of these types and morphological characters is demonstrated. w_1 and y_3 act both as embryonic and seedling lethals, while the chlorophyll production of y_4y_4 varies greatly with the environment.

Hybridization in Yeast

O. Winge and O. Laustsen (*C.R. Trans. Lab. Carlsberg*, **22**, 337–352; 1939), continuing their work on yeasts, have made several hybrids between various types of yeast belonging to the species *Saccharomyces Italicus*, *S. cerevisiæ*, *S. Mandshuricus*, *S. validus*, *Zygosaccharomyces Priorianus*. Two haploid spores are placed in a drop of a culture solution and allowed to form a diploid zygote. It was found that five hybrids showed low germination (0·13 per cent) of the zygote, while six gave a germination of between 50 and 94 per cent. The relationships of the parents may therefore be determined. It is found that these relationships correspond to the properties shown by the types in biochemical fermentation.

Female Reproductive Organs of the Toad

THE female reproductive organs of the toad *Bufo arenarum*, their cyclic changes, and the effect thereon of the hypophysis, have been studied by Inés Lopez Colombo de Allende (Inst. Physiol. Cordoba, Argentina). The cycle of changes falls into three parts: a period of rest from the end of summer to the following spring; a period of activity from the last part of spring to early summer, and a period from after oviposition until the end of summer. The anterior pituitary factor induces ovolution and secretion of the glands of the Müllerian ducts. The influence of the hypophysis is complex, but on the full-grown ovary it causes the larger ovules to be freed and discharged, and this effect is produced in the isolated ovary even if this be placed in the abdomen of a male. Mammalian hypophyseal implants have no influence. Homo-implants of the hypophysis induce glandular activity in the Müllerian ducts, but repeated implants result in degeneration. Hypophysectomy induces involutive changes in the oviducts. Sexual hormones of mammals produce no effect in this toad, which is somewhat remarkable in view of their striking effects in *Xenopus lævis*.

Australian 'Sooty Moulds'

MISS EILEEN E. FISHER has recently published an important study of the 'sooty moulds' of Australia (*Ann. Bot.*, **3**, New Series, No. 10, 399; April 1939). After a critical analysis of previous investigations and a discussion of the taxonomy of these moulds, a classification is proposed by which they are grouped according to the microscopic appearance of their growth. With the exception of Trichothyriaceæ, six families are discussed. Capnodiaceæ and Chaetothyriaceæ have therefore been amended. The geographical distribution of epiphytic 'sooty moulds' is considered in relation to temperature and humidity requirements, and from this it is suggested that the rarity of species of Capnodiaceæ in cool temperate climates may be due to the deciduous vegetation. A bibliography, four text-figures and one plate are appended.

Parasitism of the Pitch-Crust Fungus

THE pitch-crust fungus, *Ustulina vulgaris*, causes a disease of the heart-rot type in trees of temperate climates. W. H. Wilkins has made several studies of the means of infection, and in the latest paper (*Trans. Brit. Mycol. Soc.*, **23**, Pt. 1, 65–85; May 1939) he concludes that conidia of the fungus are the most probable means of infection in Nature. They are produced in abundance, are easily dispersed, they germinate readily at the temperature of normal climate, and their germ tubes penetrate most kinds of timber quite readily. The author, moreover, came to the conclusion in an earlier paper that ascospores could not infect timber under natural conditions. The conidia are about $7{\cdot}3\mu \times 3\mu$; they germinate readily between 5° C. and 30° C., and between relative acidities of *p*H 2 and *p*H 9. Oak wood is not readily penetrated, and the fungus seems to enter green wood more easily than seasoned timber. The paper contains other details of spore longevity and germination, and has adequately paved the way for further studies upon control of this particular heart-rot.

White Mould Disease of the Daffodil

THE fungus *Ramularia Vallisumbrosæ* attacks the leaves of all varieties of Narcissi, and often assumes epidemic proportions in districts where daffodils are grown for flower production. Taxonomic characters and the life-history of the parasite have been studied by P. H. Gregory (*Trans. Brit. Mycol. Soc.*, **23**, No. 1, 24–54, May 1939), who also has a further investigation in progress upon control of the malady. Sunken grey lesions appear on the leaves, and later produce conidia, which can re-infect other foliage. The fungus makes small sclerotia when the dormant period deprives it of the green parts of its host. Sclerotia have not been found in the bulb, and the organism appears to depend upon the production of conidia from sclerotia in spring, for re-infection from year to year. This fact should be important in control of the disease, for dead infected leaves could be removed. Isolation and re-inoculation experiments from conidia upon the leaves and from sclerotia have

confirmed the essential features of the life-history. *R. Vallisumbrosæ* was first described by Cavara in 1899; but *Cercosporella Narcissi*, described by Boudier two years later, appears to be synonymous. Spore characters of the fungus warrant its inclusion in either of the genera mentioned, but the retention of the earlier name is proposed in the present paper.

Long-Wave Phase of Earthquakes

CONTINUING his work on this phase of earthquakes, Stoneley (*Mon. Not. Roy. Astro. Soc.*, Geophys. Supp., **4**, No. 7, 562; June 1939) has made an analysis of the times of transit of the phase as given in the International Seismological Summary for fifteen well-observed earthquakes, and has shown that this gives a frequency distribution which is strongly double-humped. The maxima correspond to travel-rates of approximately 0·420 and 0·467 minutes per degree, and these refer to the onsets of the Love-wave and Rayleigh-wave phases which are usually denoted by *LQ* and *LR* respectively. Significant differences in the relative frequency of *LQ* and *LR* in different shocks are shown to occur for earthquakes in the same epicentral region, and these seem to indicate, according to the author, differences in the type of dislocation at the focus. It is pointed out that the ratio of the velocities is 0·90, which is in fair agreement with the predicted ratio of 0·92.

Scattering of Protons by Protons

R. G. Herb, D. W. Kerst, D. B. Parkinson and G. J. Plain (*Phys. Rev.*, **55**, 998; 1939) have investigated very carefully the scattering of protons in hydrogen for angles between 15° and 45° and proton energies between 0·86 mev. and 2·4 mev. Full experimental details are given in the paper. Rather elaborate work is necessary to determine the absolute scattering cross-sections for comparison with Mott's theoretical calculations. The scattering at 15° agrees well with this theory for all energies, but at larger angles and high energies the observed scattering is much larger than the theoretical. It is 43 times as big as the theory predicts at 45° and 2·4 mev. energy. G. Breit, H. M. Thaxton and L. Eisenbud (*Phys. Rev.*, **55**, 1018; 1939) discuss the theoretical significance of these and other recent experiments on proton proton scattering. The calculation of experimental corrections is discussed at length, and the results are then analysed in terms of the nuclear forces. No evidence was found for a nuclear p wave, and a good fit was obtained with an s wave and an interaction potential of 'square well' shape with a radius $= 1 \times e^2/mc^2$: $2{\cdot}8\ 10^{-13}$ cm. A potential curve of 'Gaussian' form could also be made to explain the results with appropriate choice of parameters.

Spectrum of Comet 1939*d*

A COMMUNICATION has been received from F. Hinderer, Babelsberg, through *Zirkular der Astronomischen Nachrichten*, which describes the spectrum of this comet. Using the Babelsberg reflecting prismatic camera with a dispersion 240 A./mm. at the $H\gamma$ line on April $18^d\ 20^h\ 43^m$ U.T. and also at $21^h\ 04^m$ U.T. an extraordinarily fine detail of structure was revealed. In the head there was a continuous spectrum with very strong emission bands. These were clearly and sharply differentiated, and the edges of the single bands were visible. In the violet end of the spectrum the emission heads 4200, 4050 and especially 3885 were the strongest members of the cyanogen bands. In the first to the fourth carbon bands (C_3), approximate wave-lengths 5635, 5540, 5585, 5129–5165, and 4685–4737, the strong heads of these were largely responsible for the yellow colour in the integrated light of the comet. In addition, there was an emission at about 4300 and also an emission on the red side of the first carbon band. As the direction of dispersion and that of the tail are in close coincidence, little can be said about the spectrum of the latter. Certainly, in accordance with the usual experience in cometary spectra, the bands mentioned above in the spectrum of the head are absent in that of the tail, although the first emission bands between 5635 and the red limit of sensitivity of the plate is found again in the tail.

Rate of Rotation of the Earth

IN a paper entitled "The Rotation of the Earth, and the Secular Accelerations of the Sun, Moon and Planets" (*Mon. Not. Roy. Astro. Soc.*, **99**, 7; May 1939) H. Spencer Jones derives important results for the accurate prediction of eclipses, if the tabular error of the moon's longitude is known. It has been established that the fluctuations in the longitudes of the sun, Mercury and Venus run closely parallel to those of the moon's longitude, for which reason all these fluctuations have been attributed to a common cause—a variation of the adopted unit of time provided by the rotation of the earth. The variations in the rotation of the earth have been attributed to tidal friction, and also to changes in the moment of inertia of the earth, due to some redistribution of matter in its interior. If changes in the moment of inertia of the earth take place, the effects on the longitudes of the sun, moon and planets are proportional to the respective mean motions of these bodies. In the case of tidal friction, a change in the angular momentum of the earth occurs and this must be compensated by a corresponding change in the angular momentum of the moon's orbital rotation. The effect on the longitude of the moon is too small to be predicted by theory. Observational data confirm the view previously mentioned that the secular accelerations are proportional to the mean motions, but the results for Venus do not cover a long enough period to determine the secular acceleration of this planet with great accuracy. It is interesting to notice that the effects of tidal friction are less at present than the average effects over the past 2,000 years. In addition, de Sitter's suggestion that large and sudden fluctuations in tidal friction take place has not been confirmed. The results obtained can be summarized as follows: Let ΔL, Δl_1, Δl_2 be the corrections required to the mean longitudes of the sun, Mercury and Venus, respectively, as given by Newcomb's Tables, and let T be expressed in centuries measured from 1900·0. A quantity β, defined as the *fluctuation* in the moon's longitude, is obtained from the moon's observed longitude, to which certain corrections for Brown's Tables are applied. Then:

$$\Delta L = 1{\cdot}00'' + 2{\cdot}97'' T + 1{\cdot}23'' T^2 + 0{\cdot}0747\,\beta$$
$$\Delta l_1 = 4{\cdot}96'' + 13{\cdot}08'' T + 5{\cdot}10'' T^2 + 0{\cdot}310\,\beta$$
$$\Delta l_2 = 2{\cdot}26'' + 5{\cdot}39'' T + 2{\cdot}00'' T^2 + 0{\cdot}112\,\beta.$$

KENYA'S PASTORAL NEEDS

IN 1929, an agricultural commission under Sir Daniel Hall reported on the grave condition to which certain native reserves in Kenya had been reduced as a consequence of overgrazing and soil erosion, and recommended an immediate reduction in livestock and an increase in agriculture as means of countering a serious and growing menace to the existence of the country. In 1931, Sir Frank Stockdale reported that an increase in agriculture and consequent reduction of area available for grazing were accentuating the dangers of erosion. In 1933, the Kenya Land Commission recommended an extension of the cropped area, using dry-farming methods, in order to increase production in densely populated reserves. In 1936, Sir Alan Pim's report on Kenya directed attention to the danger of extending the cultivated area without suitable precautions being taken to maintain fertility, and to the absence of any definite policy with regard to soil erosion. In 1937, both Sir Frank Stockdale and the recently appointed soil conservation officer (Mr. C. Maher) expressed the view that the overworked land needed a complete and prolonged rest without which much of it was irretrievably doomed. They further recommended the development and intensification of agriculture to compensate for loss of production from 'rested' land.

This summary of the recommendations of some of the consulting 'physicians' who have attended Kenya in the last ten years of its decline is given (in more detail) in Dr. Pole-Evans's account of a visit to the Colony last year.* It will be noticed that all the other physicians recognized that the worst affected parts needed rest, but proposed to maintain productive capacity by throwing an additional burden on to other parts, that is, by extending agriculture. That the productive capacity of the native reserves must be maintained at a certain minimum in the immediate interests of the inhabitants is the burden of these physicians' arguments. Dr. Pole-Evans is more forthright in his recommendations. He is a South African ecologist who lacks the bedside manner of the official reporter or commissioner. He considers that the situation is so grave that the complete rest which should have been given years ago is now imperative and must be given regardless of economic and political obstacles, if a greater future disaster is to be avoided. The remedy he proposes is simple on paper; it has been used time and again in history to rest exhausted land while keeping it under human control, and it has rarely failed. It consists in restoring the natural grass cover and utilizing animals in suitable numbers to keep the grass in good condition. It means a general reversion to less productive pastoral farming with greatly reduced stock in densely populated native reserves. Dr. Pole-Evans admits the value of supplementary measures of soil conservation—afforestation, terracing, strip-cropping, etc.—but they are practically useless unless the foundations of native society are grounded in pastures. The population can only support itself on a predominantly pastoral basis if administrative intelligence and action are concentrated on the problem of growing luxuriant grass on exhausted land in a semi-arid climate. The solution of that problem will demand all the resources of science backed by wise and far-sighted administration, and Dr. Pole-Evans's report is a plea that the necessary help and encouragement of the right kind be given before it is too late.

The report is depressing in the extreme, but it carries deadly conviction. One wishes that it could be read and its implications understood by every member of parliament. We might then get the beginnings of a Colonial policy which takes account of the harsh—the very harsh—realities of Nature that will determine policy in the end.

G. V. J.

* Report on a visit to Kenya. By Dr. I. B. Pole-Evans. Pp. 36+18 plates. (Nairobi: Government Printer, 1939.) 2s. 6d.

THE ROYAL SOCIETY OF CANADA

ANNUAL MEETING

THE annual meeting of the Royal Society of Canada was held at the University of Montreal in the new Botanical Building during May 22–24. A large attendance of fellows from all parts of Canada had an opportunity of seeing this splendid new development of a botanical garden in Montreal with its laboratories, greenhouses and large park still in the progress of completion as a works project financed by civic and Government authorities and under the direction of Frère Marie-Victorin of the University of Montreal.

The presidential address was delivered by Dr. Victor Morin, who spoke on "La Chanson Française à travers les siècles", with interpretations of songs by the "Quatuor des Alouettes". This address was preceded by the introduction of new fellows and by the presentation of medals awarded by the Society. The Flavelle Medal was awarded posthumously to the late Prof. J. Playfair McMurrich in recognition of his distinguished work in anatomy. Dr. Wilfred Bovey received the Lorne Pierce Medal, and the Tyrrell Medal was presented to Dr. E. Z. Massicotte. A unique social feature of the meeting was the Operetta-dinner held in the ballroom of the Mount Royal Hotel, at which the fellows and their wives were the guests of the City of Montreal. This fanciful dinner-play was written by the president of the Society, Dr. Morin, as a reconstitution of the feasts given by the 'seigneurs' of olden times. Parodical rhymes on gastronomical subjects adapted to the music of well-known operas of the French repertory were sung by artists in cook's and maid's costumes, as the several dishes of the dinner were served.

At the concluding general meeting, Dr. H. M. Tory was elected the new president of the Society.

Section III (Chemical, Mathematical and Physical Sciences) was held under the presidency of Prof. S. Beatty, who delivered the presidential address on "Generalisation as a Principle of Mathematics". Three new members were elected to this section, Prof. H. N. Brocklesby, Prof. M. F. Crawford and Prof. G. Herzberg. In all, 120 papers were presented and the section split into the three subdivisions to facilitate the giving of the papers during the time of the meeting.

Prof. E. F. Burton spoke on a number of papers contributed by his co-workers, among which special mention should be made of the recent results obtained by Johns, Wilhelm and Grayson Smith on the flow and viscosity of liquid helium, in which it was proved, by using glass capillaries ranging from 0·025 cm. to 0·0036 cm. in diameter and with lengths varying from 2 cm. to 26 cm., that normal laminar flow was obtained for He I with a viscosity of the order of 10^{-5} c.g.s. units, while for He II, the flow could be expressed as the sum of a laminar flow plus an additional pressure-independent flow. The laminar portion obeyed Poiseuille's law and gave a viscosity of the order of 10^{-5} c.g.s. units. The new electron microscope constructed by A. Prebus and J. Hillier and photographs obtained with it indicating high resolving power were described by Dr. Burton. Among the papers presented by Prof. J. A. Gray, one in collaboration with J. S. Marshall and A. G. Wood contained results on the scattering of β-rays using metallic foils, which were in contradiction to those obtained by other observers using expansion chamber methods. Dr. D. C. Rose described an electromagnetic pick-up device used with a cathode ray oscillograph for investigating vibrations in aeroplanes during flight. A new method of observing the Raman effect in small amounts of liquid with short exposure times was presented by Prof. M. F. Crawford and H. L. Walsh.

A description of the methods now being used to determine the upper earth structure from data obtained by registering the seismic waves from rock bursts occurring in mines was given by Dr. E. A. Hodgson. Other papers on field results of geophysical investigations were given by Dr. A. A. Brant, Prof. L. Gilchrist and Prof. D. A. Keys. The results of an analysis of meteorological data by A. Thomson showed that the average winter temperature was 4° F. warmer in Manitoba and Saskatchewan for the period 1919–1938 than for the period 1884–1903, which was explained by the increase in the temperature of the air-masses moving in from the Arctic circle.

Among the fifteen papers presented by Prof. O. Maass and his associates, particular interest was taken in those dealing with the measurements of viscosity, opalescence, specific heat, density and solubility relations of various liquids and vapours in the critical temperature region. The influence of intense mechanical stirring on the temperature at which the disappearance of the meniscus takes place shows that a wide range of over-all density gives identical critical temperatures. Prof. E. W. Steacie presented eight papers dealing with various aspects of photosensitized decomposition. Prof. R. H. Clark and his collaborators contributed fourteen papers, among which special mention may be made of the results obtained on activators of zymase. The plant hormones activate live yeast but have little accelerating effect on zymin. Another paper of interest was on the mechanism of the flotation of galena in the presence of xanthate which is applied in the mining industry in Canada. Prof. H. Hibbert spoke on the results obtained in his laboratory, carried out with various collaborators, on lignin and other wood products.

In the mathematical and astronomical section, M. S. McPhail and Prof. R. L. Jeffery spoke on Stieltjes integrals with applications to fractional integrals. The profiles of hydrogen lines in the spectrum of *H.D.* 190073 by C. S. Beals and an investigation into the hydrogen line contours in the spectra of solar stars by K. O. Wright were given by Dr. W. E. Harper. Dr. A. V. Douglas, D. C. West and D. E. Guignard described an investigation on the profiles of hydrogen lines in two class *B* stars.

Prof. J. A. Gray was elected president of the section and Prof. J. K. Robertson secretary.

In Section IV (Geological Sciences) the presidential address by Dr. M. E. Wilson outlined the development of ideas about the Canadian Precambrian and discussed certain Precambrian problems. Eighteen papers were presented. Two papers dealt with Sudbury, one by Dr. H. C. Cooke, in which some new ideas about the general geology of the district were given, and the other by Dr. A. B. Yates concerned with the ore deposition. Dr. H. C. Gunning and J. W. Ambrose outlined the results of five years detailed investigation of the so-called Timiskaming-Keewatin contact in Rouyn-Harricanaw Area, Quebec. The whole succession of volcanic and sedimentary rocks is apparently conformable and the investigations show the need for complete revision of our conceptions of Archean stratigraphy and structure in this part of the Canadian shield.

The palæontological papers included descriptions of a Helderber fauna from the eastern townships of Quebec by D. T. H. Clark, and some species of Neo-Triassic ammonites by D. L. H. McLearn. Dr. J. T. Wilson presented an interesting paper on the Eskers north-east of Great Slave Lake, N.W.T. The information was gained chiefly from the study of aerial photographs.

Dr. H. W. Fairbairn presented a paper on the fracture hypothesis of quartz orientation in tectonites. Dr. M. B. Baker discussed the floor of the Palæozoic rocks in Canada.

The presidential address of Section V (Biological Sciences) was delivered by Dr. J. M. Swaine of Ottawa on "Scientific Research as the Key to Progress in Agriculture".

The programme comprised seventy-two papers, of which nineteen came before the medical subsection, and twenty-nine were botanical.

Dr. N. H. Grace reported upon the relative physiological activity of the members of a series of naphthyl acids when applied to plant cuttings, showing that those with an even number of carbon atoms in the side chain are the more active. Drs. E. Gordon Young and R. W. Begg found certain small proportions of copper, calcium, magnesium, and iron to be required in bacterial culture media. Factors affecting stomatal movement in the dark were described by J. H. Whyte. That increased permeability of the host accompanies increased susceptibility to parasites and diseases in plants was shown by F. S. Thatcher. The importance of boron for normal cell division, enlargement, and maturation in plants was

described by J. G. Coulson and R. O. Lachance, while studies related to hardiness of plants were reported by Messrs. J. Levitt and D. Siminovitch. R. B. Thomson discussed the structure of the pollen cone of Austrotaxus and its phylogenetic significance, showing it to be a highly specialized derivative of the usual conifer type, and C. N. Haldenby described the distribution and origin of horizontal resin canals in Coniferæ. A series of papers by Frère Marie-Victorin was devoted to various taxonomic and distributional studies of the plants of Quebec and of Cuba, interesting contributions to the problem of relic floras being made, particularly in papers by MM. Roussear and Gauthier.

In the field of genetics, a definite relationship between sterility and chromosome segregation with translocations was demonstrated in wheat crossed by W. P. Thompson, and the actual causes of failure of seed-setting in certain intergeneric cereal crosses were described in another paper by the same investigator. F. H. Peto gave an account of the production of fertile amphibolypoid plants from sterile hybrids of Triticum species, and A. Glaucum, by temperature and colchicine treatments, with cytological studies of the processes involved. Certain chromosome mutations in oats were shown by H. G. F. Sander to involve loss of all parts of one chromosome, and studies on the chromosomes of Trillium by G. B. Wilson and H. B. Newcombe gave data which cannot readily be fitted to any existing theory of crossing over but suggest a new partial hypothesis.

Features of the morphology of the circulatory system of Amia, particularly in relation to an air-breathing mechanism, were described by V. C. Wynne-Edwards, and the presence of a vessel of portal nature connecting the hypophysis and the hypothalmus in the frog was reported by E. Horne Craigie. The latter also demonstrated wide and important differences in the vascular richness of hypothalamic centres in the rat. Various studies on the white whale were reported by V. D. Vladykov, who also discussed sexual dimorphism in the speckled trout. F. E. J. Fry had a paper on density of lake trout populations. An account of differential growth rates and of regeneration in the hind limb of the frog was offered by A. Emerson Warren. A study of temperature relations of the numerous species of midges (Chironomidæ) occurring in a lake was described by R. B. Miller.

B. P. Babkin and associates showed that ergosterol and parathyroid hormone effect gastric secretion in the dog chiefly by depressing its nervous phase. Early cessation of growth in rats on a rich fat diet was found by R. G. Sinclair and traced to the masking or suppression of synthesis of essential fatty acids. The effect of guaiacols on the respiratory passages was described by E. M. Boyd. Authentic notochordal tissue in a dermoid cyst of the ovary was reported by J. L. Riopelle. The structure and development of certain renal tumours led P. Masson to believe that the metanephros is not mesodermal but is derived from the neural crest; while his associate, P. Simard, found a constant neuroinsular complex in the mammalian apparatus. Drs. A. Scott and A. M. Fisher gave an account of the effects of certain chemicals in inactivating insulin and showed by moving picture film that each insulin crystal has two parallel square surfaces relatively close together, connected by four oblique quadrilateral surfaces. James Craigie showed that the Guarnieri inclusion bodies are probably not the intracellular colonies of a virus. The chemotactic attraction of staphylococci for leucocytes from mouse spleen was found by J. W. Stevenson and G. B. Reed to vary inversely with pathogenicity, while Alma Howard reported an inverse relationship between chiasma frequency in chromosomes and susceptibility to mammary gland carcinoma in mice.

THE AGRICULTURAL EDUCATION ASSOCIATION

Annual Conference at Belfast

THAT science can do much to help agriculture was the theme of several speakers at the Annual Conference of the Agricultural Education Association which was recently held at Belfast. Both Lord Craigavon (Prime Minister) and Sir Basil Brooke (Minister of Agriculture) referred with pride to the achievements of the Education and Research Divisions of the Northern Ireland Government at the official dinner of welcome, and reiterated the opinion that education, both general and technical, is a sound investment. The Association, which met under the chairmanship of Mr. W. B. Mercer, had a long programme of scientific papers, interspersed with visits to the Agricultural Research Institute at Hillsborough, with its experimental farm of 500 acres, the Plant Breeding Station and Veterinary Research Laboratory at Stormont, and farms of the Irish Peat Development Company at Maghery.

Dr. H. H. Corner directed attention to recent work on 'pine' disease in sheep, which he declared was prevalent in the highlands of Scotland, the border counties, parts of Wales and in Devonshire. 'Pine' is an anæmic wasting disease due to a condition in which the iron of the food cannot be utilized by the blood: the presence of numerous parasitic intestinal worms is a secondary condition. Following the success of Underwood in Australia, who in 1934 showed that cobalt was the potent element in the utilization of iron compounds in enzootic marasmus, cobalt was tried in the treatment of 'pine' in the Cheviot region with great success. One ounce of cobalt chloride sprayed into and well mixed with one hundredweight each of steamed bone flour and common salt, provided an easy means of preventing the disease, for the mixture could be set out in boxes for the animals to eat whenever they felt inclined. The cost was twopence a sheep per year.

Mr. James Mackintosh, as the result of two years experimental work with large numbers of cows in the south of England, suggested that a 20 per cent reduction might safely be made in the amount of protein now being fed to dairy cows. He suggested a

standard of 0·5 lb. protein equivalent per 10 lb. of milk of average quality as a safe standard for farm practice.

Prof. R. G. Baskett, in a paper dealing with the firmness of fat in bacon pigs, stated that the back fat of pigs receiving de-germed maize meal had a significantly lower iodine value than that of pigs receiving half their ration in the form of maize meal.

Mr. H. Trefor Jones, in a paper on smoke pollution, said that in a town the size of Leeds domestic chimneys alone contribute to the atmosphere the equivalent of nearly a ton of sulphuric acid per acre per annum : in the industrial districts of the West Riding of Yorkshire, however, the sulphurous fumes are contributed chiefly by industrial chimneys and smouldering pit heaps. Most of the damage to crops is done during the dormant season : winter-sown crops like wheat and winter vegetables are the chief sufferers, whilst it is unsafe to spray potatoes with copper preparations even under conditions of mild pollution. In confirming or disproving cases of alleged smoke damage, and in explaining differences in productivity of the various parts of affected fields, the estimation of the sulphate content in the soil had proved very useful. Sulphate figures in excess of 0·020 per cent for grassland, and 0·030 per cent for arable land indicate smoke pollution.

Prof. S. P. Mercer had a good word to say for Yorkshire fog grass under certain conditions in Northern Ireland, advocated shorter leys combined with August sowing, and stated that rushes could be very largely controlled by two cuttings a year for two successive seasons. Dr. A. E. Muskett described a laboratory method which allows seed disinfectants to be tested for efficiency in ten days at any time of the year. Radiation for 20 minutes with a quartz mercury vapour lamp is used to promote sporulation of the fungus, thus making easier the examination of the seeds at the end of the test. Dr. J. Carroll stated that until recently eelworms had not been a serious pest in Eire, but that root eelworm of potatoes was spreading and that the bulb strain of *Anguillulina dipsaci* was beginning to attack onions, a crop which during the last few years had undergone a remarkable increase in Eire. Mr. R. Chamberlain described the extraordinary but successful measures adopted in Northern Ireland to stamp out the chrysanthemum midge, measures which included the scheduling of an area within which no living chrysanthemum plant could be kept, and the intensive inspection of all premises in the area.

Other papers read at the meeting included contributions on aspects of education by Mr. S. J. Wright and Mr. J. Getty : a paper on the flax-growing industry, by Mr. W. J. Megaw, peat land reclamation, by Mr. J. C. Baird, and a general account of the agriculture of Northern Ireland by Mr. J. Morrison.

UNION BETWEEN HOST AND PARASITE IN HIGHER PLANTS

ON this subject, Schumacher and Halbsguth have recently published an interesting and suggestive paper[1]. Their observations are based on extensive studies of species of Cuscuta and Orobanche on a wide range of host plants ; with the union of Cuscuta and its host, particularly, they have made use of techniques which permit the recognition of protoplasmic connexions, usually freezing the material, cutting on the sliding microtome and then transferring immediately to iodine potassium-iodide solution. Afterwards the walls were swollen and the connexions stained by a modification of Meyer's pyoctannin method.

In all cases they find (contrary to some earlier observations of Mrs. Thoday[2]) no direct connexion between the sieve-tubes of host and parasite ; the sieve-tubes of the parasite, indeed, are not found differentiated in the close neighbourhood of the point of union in the haustorium. From the haustorium, in Cuscuta, hypha-like cells ramify from the parasite penetrating the phloem tissue ; where these cells end in the neighbourhood of a sieve-tube they may develop a comb-like expansion of which the teeth close on the sieve-tube, so that these cells make very good contact with the sieve-tube, of which the wall is often much compressed. In the walls of these hyphæ, which are rich in protoplasm and often multinucleate, very numerous plasmodesma-like structures are found which seem to end free on their surface, but these 'plasmodesma' are never found on the comb-like ends, which seem definitely constructed to facilitate exchange between host sieve-tube and parasite.

In Orobanche these hypha-like cells are usually replaced by a densely plasmatic tissue, with prominent, usually single, nuclei ; these cells multiply rapidly, they surround and compress and finally obliterate many of the sieve-tubes ; but the sieve-tube up to the point of obliteration remains full of contents and presumably continues to transfer material from host to this secretory type of haustorial tissue.

The authors conclude that their observations suggest that the transfer of food from host to parasite must take place across the walls of contiguous cells, the permeability of host sieve-tube presumably increasing, whilst the absorptive properties of the haustorial secretory tissues may also be accentuated at the point of union. The distribution of the protoplasmic connexions suggests that food transfer is not their role. It is argued they may help the invading haustorial cells to orientate themselves in the host and, in accordance with such perceptive functions, the authors record the presence of similar structures in the outer wall of epidermal cells, notably of tendrils. But their figures suggest that these structures are rather large for typical protoplasmic connexions and it must be left for further work to clear up the possible correlation of these epidermal features with plasmodesma or, on the other hand, with the wax-secreting channels described by Dous and Ziegenspeck[3]. These vertical wax-secreting channels also deserve further scrutiny in view of Madeleine Meyer's observations[4] that the wax distribution suggests its movement along horizontal channels in the cutinized layers of the outer wall.

[1] *Jahrb. wiss. Bot.*, **87** (2/3), 324–355 (1938).
[2] *Ann. Bot.* (1911).
[3] *Bot. Archiv.*, **19** (1927) ; **29** (1928).
[4] *Protoplasma*, **29** (1938).

NEW FORENSIC SCIENCE LABORATORY

THE new Home Office Laboratory at Preston was opened on July 27 by Mr. A. L. Dixon, Assistant Under-Secretary of State of the Home Department. The staff and equipment are provided by the Home Office, which also meets the running costs during the initial period. The accommodation has been provided by the Lancashire Standing Joint Committee. The Laboratory will serve the North-Western Area, which includes Lancashire, Westmorland and Cumberland and Cheshire.

The new Laboratory is conveniently arranged on one floor. The administrative offices are arranged in a central hall, from which the various laboratory sections are readily accessible. The Laboratory is furnished with modern equipment for carrying out chemical (including microchemical), physical and biological investigations. There is also a fully equipped photographic section, including apparatus for microphotographic work.

This is the fourth laboratory to be established, others being at Birmingham, Cardiff and Nottingham. Each laboratory is equipped to cover the range of work which would satisfy all general requirements, but it would be impossible to equip each laboratory to cover every possible case. This aspect is, however, largely met by giving each laboratory some special section, and in the case of the laboratory at Preston, the provision for dealing with chemistry problems is made as complete as is reasonably possible. Thus by reciprocal arrangements between these forensic science laboratories (and in special cases certain Government laboratories) it is possible to cover practically every phase of the work.

The principal function of the Laboratory is to give scientific assistance in the detection of crime to the police in the area served by the Laboratory. The police, however, have no control over the work which goes on in the Laboratory; that work is solely under the control of the Director. He has only one thing to do—to find out what the various specimens submitted (and in some cases his observations at the scene of crime) reveal from the scientific point of view. It may well be that the results completely negative the police case and favour the defence. That is no concern of the Director; he will state his findings, which will be available to both sides.

In addition to the purely laboratory work, it is part of the work of the Director to organize courses of instruction which are available to the various detective forces in the area. This course includes the careful collection and preservation of materials to be submitted to the Laboratory for examination.

The Laboratory, therefore, includes a museum in which exhibits from various typical crimes will be collected and used for instructional purposes. Although the new buildings have only been recently opened, the Laboratory was first started in September 1938 in temporary premises with Dr. J. B. Firth as director, and in this interim period on no less than 140 occasions have materials been submitted for examination and some 556 exhibits examined. These figures themselves will indicate in some measure that the new Laboratory with its more complete staff and equipment will be a great asset to the area which it is designed to serve.

J. B. F.

SCIENCE NEWS A CENTURY AGO

Drainage of Lands by Steam Power

THE *Gentleman's Magazine* of August 1839 contains the following information: "The drainage of land by steam power has been extensively adopted in the fens of Lincolnshire, Cambridgeshire and Bedfordshire, and with immense advantage. A steam engine of ten horse-power has been found sufficient to drain a district comprising a thousand acres of land, and the water can always be kept down to any given distance below the plants. If the rainfall is excessive, the water is thrown off by the engine; if the weather is dry, the sluices can be opened and the water let in from the river. The engines are required to work four months in the twelve, at intervals varying with the season; where the districts are large, the expense of drainage by steam power is about 2*s*. 6*d*. per acre."

The Travels of J. D. Forbes in 1839

EARLY in August 1839, J. D. Forbes returned to Edinburgh after spending three months in south-east France, Switzerland and Italy. On his way south he visited Paris, meeting Arago, Cauchy, Elie de Beaumont and Niepce, and was particularly interested in Daguerre's pictures. He then travelled south by way of Dijon, Chalons and Lyons on the way to the department of Ardêche. From Montpezat he wrote of the district that "in a geological sense it is interesting in the highest degree, and I have four or five craters, just as well-defined and as recent-looking as Vesuvius, within a day's walk. . . . There are deep granite valleys divided by serrated mountains, through which here and there a cindery volcano thrusts his roasted head, while the valleys are clothed with chestnut and mulberry trees in the most exquisite manner". On July 5 he made an investigation of a meteorite which fell on June 15, 1821, "one of the very few which have fallen so near to intellegent spectators as actually to endanger their lives".

From the volcanoes of Auvergne, Forbes proceeded to Marseilles and then turned north to explore the little-frequented valleys around Monte Viso on the borders of Piedmont. He visited the village of St. Veran, 6591 ft. above sea-level, "the highest in Europe, except that of Soglio in the Tyrol", and attempted the circuit of Monte Viso. From these excursions he returned to Grenoble, and then having visited a brother at Geneva he travelled through some of the unknown valleys to the south, and then by way of Cogne and Ponte he reached Turin. On August 2 he visited the astronomer Plana, "overwhelmed with official engagements", and on the following day the geologist Sismondi.

Kent Zoological and Botanical Gardens

ON Thursday, August 8, 1839, "a party of citizens visited this delightful spot in a steamer, when about 650 gentlemen and ladies were regaled with a dejeuner, under a spacious pavilion erected in the gardens for the occasion. . . . The gardens are those at Rosherville near Gravesend. This piece of land, or the greater portion of it, consisting of seventeen acres, was taken into its hands by a company of gentlemen more than a year since, and by then it was made the object of a most extensive plan for the securing of its natural beauties and adding to it new and unusual attractions. . . . Clever use has been made of the excavation into the chalk cliffs . . . a further advance in the valley conducts to the botanical beds where it is

intended to cultivate the rarest plants and flowers which the climate will allow. . . . Immediately next the perpendicular cliffs of these two divisions arrangements are to be made and are now in progress for the reception of wild beasts, birds and sea-fowl, etc." (*Mechanic and Chemist.*)

Thomas Tredgold

TREDGOLD, one of the founders of engineering theory and the author of the well-known definition of civil engineering embodied in the charter of the Institution of Civil Engineers, died in January 1829 at forty years of age, worn out by his exertions.

On August 10, 1839, the *Mechanics' Magazine* said, "To architects, engineers and persons concerned in any department of building the name of Tredgold must not only be familiar, but likewise respected and valued, and it is presumed not less so by many individuals in the higher walks of life. To all such it must be a matter of painful interest to be informed that the family of such a highly gifted man and martyr to science, consisting of an aged mother, two daughters in extremely delicate health, and a son of about thirteen years of age, are in very dependent circumstances. His friends have long cherished the hope that long before this time—for it is now ten years since his death—their situation might have attracted the favourable notice of government; but as this has not been the case, Mr. Habershon, one of his early friends and his biographer, with John Donkin, Esq., his joint executor, have commenced a subscription in furtherance of this laudable object."

Discovery of a Mammoth's Tusk

THE issue of the *Athenæum* of August 10, 1839, states that at a meeting of the Bristol Philosophical Society "Dr. Fairbrother exhibited the tusk of a mammoth which had been found on the line of the Great Western Railway, near the spot where the city boundary crosses the line . . . in the lower part of a bed of gravel which reposes upon red sandy and marly beds, forming a part of the 'New Red Sandstone' formation. Its length is about 5½ feet, its circumference varying from 21 to 10 inches. It is curved in a form nearly circular and occupies an arc of about 140 degrees. Mr. Stutchbury supposes it to be a part only of the original tusk, which was probably 9 feet in length."

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

ASSISTANT II under the Ordnance Board, Woolwich—Secretary (S.E.3), Ministry of Supply, The Adelphi, W.C.2 (quoting Appts. 01/S.E.3) (August 11).

ASSISTANT I at Air Ministry Headquarters—Under-Secretary of State, Air Ministry (S2A/B8019), Berkeley Square House, Berkeley Square, W.1 (quoting Ref. No. B.229) (August 11).

TEMPORARY ASSISTANTS Grade III (Male) in the Meteorological Office—Under Secretary of State, S.2.B.(Met.), Air Ministry, Adastral House, Kingsway, W.C.2 (August 14).

ASSISTANT LECTURER IN ORGANIC CHEMISTRY—Registrar, University College of the South-West, Exeter (August 19).

CHIEF ASSISTANT in the Chemistry Department—The Secretary, Robert Gordon's Technical College, Aberdeen (August 26).

LIBRARIAN in the University of Cape Town—Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (September 8).

UNIVERSITY CHAIR OF CHEMISTRY at the Royal Cancer Hospital (Free)—Academic Registrar, University of London, Senate House, W.C.1 (September 15).

ASSISTANT ENGINEER for the Malayan Public Works Service—Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/5731).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

University of Bristol. The Annual Report of the Agricultural and Horticultural Research Station (the National Fruit and Cider Institute), Long Ashton, Bristol, 1938. Pp. 295+9 plates. (Bristol: The University.) [247

Mines Department. Seventeenth Annual Report of the Safety in Mines Research Board, including a Report of Matters dealt with by the Health Advisory Committee, 1938. Pp. iv+123+10 plates. (London: H.M. Stationery Office.) 2s. net. [247

Nutrition of Children. By Eddie Williams. (Cardiff: Priory Press, Ltd.) 10s. per 100. [267

The Bronze Axe: the Seven Stages of its Development in Britain (2000–500 B.C.). By W. Foot Walker. (Booklet No. 3.) Pp. 39. (Hull: "Museum Aids".) 1s. 6d. [267

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1843 (3651): Experiments on the Transition of the Laminar Boundary Layer on a Flat Plate. By A. A. Hall and G. S. Hislop. Pp. 27. 4s. net. No. 1855 (3675): Experiments on a Riveted Wing in the Compressed Air Tunnel. By D. H. Williams and A. F. Brown. Pp. 4. 9d. net. No. 1857 (3552): A Possible Form of High Speed Water Channel. By A. M. Binnie. Pp. 9. 1s. 6d. net. (London: H.M. Stationery Office.) [267

Scientific Proceedings of the Royal Dublin Society. Vol. 22 (N.S.), No. 15: Leaf Movement on Release of Sap Tension. By Prof. Henry H. Dixon and J. S. Barlee. Pp. 175–180+plate 4. 1s. 6d. Vol. 22 (N.S.), No. 16: Studies in Peat, Part 6: The "Water Phase" in Azeotropic Extraction Solvents. By J. Reilly and D. F. Kelly. Pp. 181–186. 6d. Vol. 22 (N.S.), No. 17: Studies in Peat, Part 7: Water Distribution in Peat Wax Azeotropic Extraction Solvents. By J. Reilly, D. F. Kelly, J. Duffy and E. Coughlan. Pp. 187–194. 6d. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) [277

Other Countries

Ceylon. Part 4: Education, Science and Art (?). Administration Report of the Acting Director of Agriculture for 1937. By E. Rodrigo. Pp. D93. (Colombo: Government Record Office.) 1 rupee. [247

Indian Forest Records (New Series.) Silviculture, Vol. 3, No. 4: a Study of the Soils in the Hill Areas of Kashmir; an Investigation of Soil Profiles under Deodar, Blue Pine, Silver Fir and Chir. By Dr. R. C. Moon. Pp. 193–262. (Delhi: Manager of Publications.) 1.14 rupees; 2s. 9d. [247

Publications of the Nizamiah Observatory. Astrographic Catalogue 1900.0, Hyderabad Section (Part 3), Dec. +35° to +40°, from Photographs taken and measured at the Nizamiah Observatory, Hyderabad, under the direction of T. P. Bhaskaran. Vol. 11: Measures of Rectangular Co-ordinates and Diameters of 50,907 Star-Images on plates with Centres in Dec. +37°. Pp. xxviii+193. (Begumpet: Nizamiah Observatory.) 15 rupees; 20s. net. [257

Annales scientifiques de l'Université de Jassy. Première partie (Mathématiques, physique, chimie), Tome 25, Année 1939. Fascicule 1. Pp. 340. Fascicule 2. Pp. 341–698. Seconde partie (Sciences naturelles), Tome 25, Année 1939. Fascicule 1. Pp. 336. Fascicule 2. Pp. 337–616. (Jassy: Université de Jassy.) [257

A Trip through the New Building of Mellon Institute. Second edition. Pp. vi+20. (Pittsburgh, Pa.: Mellon Institute.) [257

U.S. Department of the Interior: Office of Education. Know your School, Leaflet No. 51: Know your School Child. By Mary Dabney Davis. Pp. iii+18. (Washington, D.C.: Government Printing Office.) 5 cents. [257

Cawthron Institute, Nelson, New Zealand. Annual Report, 1938. Pp. 35. (Nelson: Cawthron Institute.) [257

Advisory Committee on Education. Staff Study No. 1: Education in the Forty-eight States. By Payson Smith, Frank W. Wright and associates. Pp. xv+198. (Washington, D.C.: Government Printing Office.) 30 cents. [257

New York Academy of Sciences. Scientific Survey of Porto Rico and the Virgin Islands. Vol. 14, Part 3: Insects of Porto Rico and the Virgin Islands—Hemiptera-Heteroptera (excepting the Miridae and Corixidae). By Harry Gardner Barber. Pp. 261–442. (New York: New York Academy of Sciences.) 2 dollars. [257

Classified List of Smithsonian Publications available for Distribution, June 26, 1939. Compiled by Helen Munroe. (Publication 3544.) Pp. iv+35. (Washington, D.C.: Smithsonian Institution.) [257

Brooklyn Botanic Garden Record. Vol. 28, No. 3: The Rose Garden of the Brooklyn Botanic Garden. By Montague Free. (Guide No. 9.) Pp. 159–216. (Brooklyn, N.Y.: Brooklyn Institute of Arts and Sciences.) [257

U.S. Department of the Interior: Geological Survey. Water-Supply Paper 796-G: Major Texas Floods of 1935. By Tate Dalrymple and others. Pp. v+223–290+plates 54–62. 15 cents. Water-Supply Paper 823: Surface Water Supply of the United States, 1937. Part 3: Ohio River Basin. Pp. vii+375. 40 cents. Water-Supply Paper 842: Floods in the Canadian and Pecos River Basins of New Mexico, May and June 1937; with Summary of Flood Discharges in New Mexico. By Tate Dalrymple and others. Pp. iv+68+9 plates. 20 cents. (Washington, D.C.: Government Printing Office.) [257

New York Zoological Society. Report of the Director of the Aquarium. Pp. 22. (New York: New York Zoological Society.) [257

League of Nations: Information Section. Essential Facts about the League of Nations. Tenth edition, revised. Pp. 359+4 plates. (Geneva: League of Nations; London: George Allen and Unwin, Ltd.) 1s. [277